

Compressed Air Magazine

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September, 1936



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SEPTEMBER, 1936

A Monthly Publication
Devoted to the Many
Fields of Endeavor in
which Compressed Air
Serves Useful Purposes

FOUNDED 1896

Volume 41



Number 9

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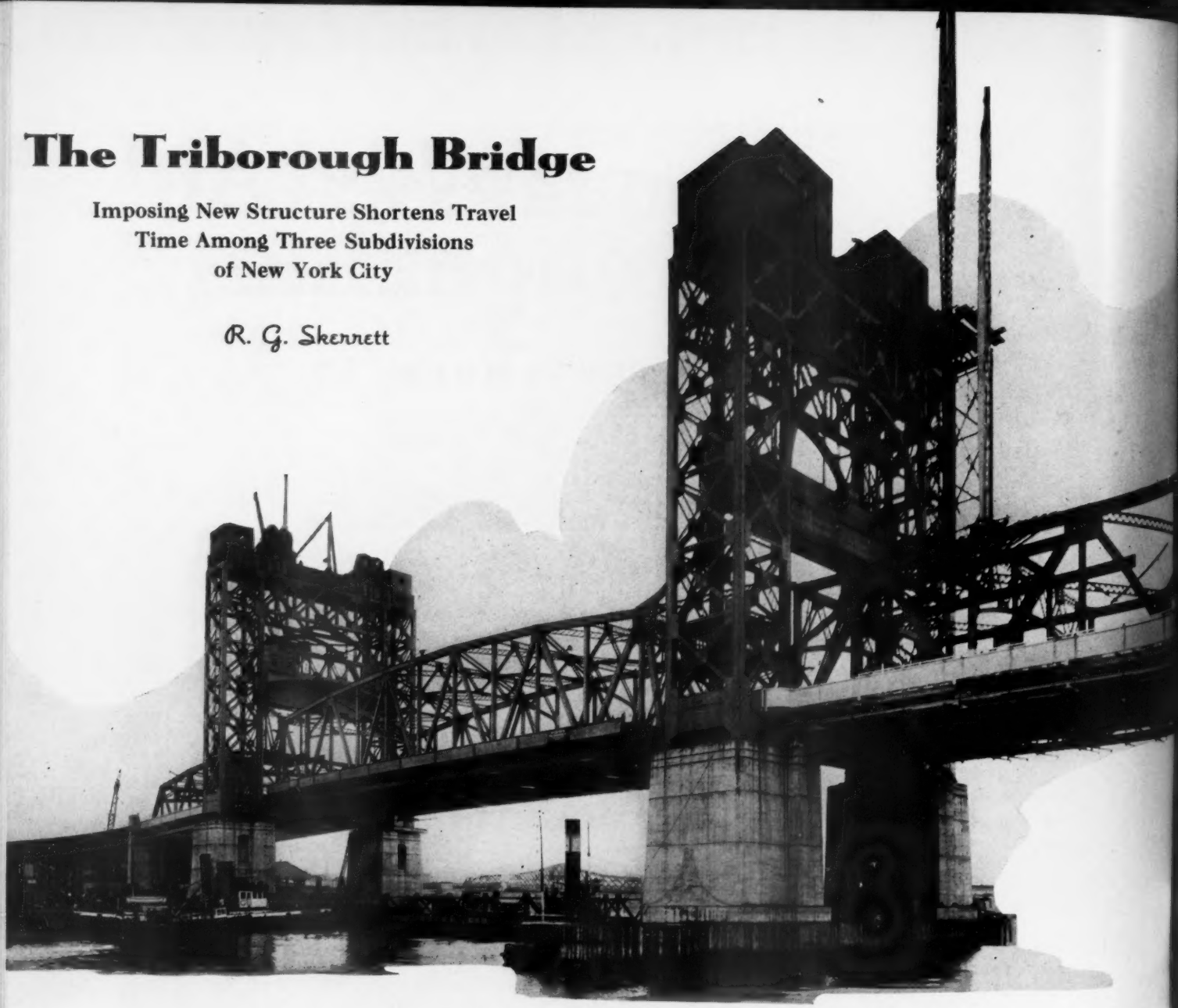
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The Triborough Bridge

Imposing New Structure Shortens Travel
Time Among Three Subdivisions
of New York City

R. G. Skerrett



HARLEM RIVER LIFT SPAN

In the position shown, the bridge clears the water by 55 feet. It can be raised 80 feet more to allow ships to pass under it. The central span is 310 feet long. The massive concrete piers

that support the towers are 50 feet high and rest on bedrock. The towers reach a total height of 220 feet. In point of floor area, but not length, this is the largest lift span yet built.

AT an outlay of more than \$60,000,000 the City of Greater New York has built and recently placed in service traffic facilities of a composite character that are officially known as the Triborough Bridge. As a matter of fact, the splendid undertaking is a series of four bridges that span four waterways and are so interconnected and associated with tributary highways as to speed up vehicular travel and to improve tremendously the interrelations of the three populous boroughs of the Metropolis that are most directly affected by the new structures.

The Triborough Bridge system, for so it should be designated, is not merely a present means of solving a traffic problem that has grown increasingly serious during the last two decades: the engineers responsible for it have envisioned the needs of years to come so that pleasure, business, and industrial vehicles can travel rapidly to and fro within the areas immediately inter-

linked and even far beyond within a radius of 50 miles and more. The four bridges and their approaches or viaducts have a united length of $3\frac{1}{2}$ miles; but the value of the new river crossings is immensely increased by 14 miles of connecting boulevards which extend in several directions and link existing long-distance highways entering and traversing adjacent states. The Triborough Bridge system is, therefore, not a great piece of engineering work intended to serve alone the locality in which it is placed. In a sense, it partakes of a national character, and is in response to the steady multiplication of motor vehicles and their ever widening fields of use.

Of course, local needs were primarily responsible for the conception of the Triborough Bridge; and the first move in that direction was made in 1916 when the Department of Plant and Structures of New York City urged the building of a triple-way bridge that would connect the bor-

oughs of Manhattan, Bronx, and Queens where those three administrative subdivisions of the Metropolis come close together but where they are separated by the East River and the Harlem River—the latter a tidal link between the Hudson River and the East River and the boundary between the northern end of Manhattan Island and the southern limits of the Bronx.

Between the foregoing date and 1929 little was done except to make preliminary surveys and borings to determine the best route for a composite crossing and to ascertain at what depths satisfactory rock could be found on which to set the piers for towers, anchorages for suspension cables, and footings for the supporting structures that would have to carry the various approaches and interconnecting viaducts. A triborough bridge was designed, and work on it was started near the end of 1929. Some progress on the essential substructures had been made when, in 1932, further activities were



Photo by Aerial Explorations, Inc.

THE BRIDGE FROM THE AIR

In the left foreground is the suspension bridge that carries the roadway from Queens borough across Hell Gate to Wards Island. Continuing onward as a viaduct, the thoroughfare traverses Wards Island and then crosses Little Hell Gate to Randalls Island. One branch goes on northward to the Bronx, in the upper right-hand corner of the picture, while the other veers off at a right angle to the left and crosses the Harlem River to Manhattan, at the upper left. The lift span across the Harlem, raised to its full height of 135 feet above the

water, is visible at the top-center. The bridge at the right-center is the Hell Gate arch, a link in the railroad that connects the Pennsylvania and New York, New Haven and Hartford systems. Just above the bridge is the new Wards Island sewage disposal plant. At the lower right is the new public swimming pool in Astoria, Queens, where the tryouts for the team that represented the United States in the Olympic Games were held. This photograph was taken on June 8, about a month before the bridge was opened.

brought to a halt by a lack of city funds. The project remained dormant between the spring of 1932 and November of 1933, when it was again taken in hand and advanced with commendable dispatch. As it now stands, the Triborough Bridge system differs radically from that planned in 1929, although fundamentally the same in principle.

The construction of the Triborough Bridge emphasizes in an interesting way what may happen in a large center of population where physical or topographical circumstances impose pronounced shifting on the part of homeseekers, factories, industrial plants of divers sorts, and the establishment in the newer sections of shops and sources of supply and service such as are always identified with any community.

In 1916, the City of Greater New York—that is, all its five boroughs, had a population of 5,312,464. In 1935, the Metropolis had 7,601,575 residents—representing a growth in nineteen years of 2,289,111. Within that span the Borough of Manhattan experienced an exodus of 647,364, so that its population today is that much less than it was in 1916. On the other hand, the Bronx advanced from 623,488 to 1,538,359—a gain of 914,871 persons. Last year the Borough of Queens had 1,391,588 inhabitants, or 989,241 more than nineteen years ago. In short, it will not be long before the Bronx and Queens will each outstrip Manhattan with its 1,660,000 residents.

The changes that have taken place, especially in the Bronx and Queens, have caused the center of population as a whole

to shift to a point close to the location of the Triborough Bridge crossings which afford vitally necessary means of intercommunication overland where no comparable conveniences were previously at the disposal of motor cars, trucks, and buses. Formerly, if one wanted to go from the Bronx to Queens across the East River, the nearest available route was by ferry, and, similarly, vehicles moving between Queens and the upper section of Manhattan either had to use a ferry line or detour southward for fully $1\frac{3}{4}$ miles to utilize the toll-free Queensboro Bridge which extends from 59th Street in Manhattan to Long Island City in Queens. One of these two ferries traverses the East River at Hell Gate, where the currents are strong and treacherous: and both cross a waterway that is

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continually traveled by craft of all sorts and sizes. Furthermore, passage from shore to shore is not infrequently slowed up and made risky by fogs and stormy weather. Even so, and despite other handicaps, the two ferries have for several years past been moving annually from borough to borough a total of approximately 2,000,000 vehicles, showing that owners and operators were willing to pay for the transit because of the time saved rather than follow crowded city thoroughfares to reach the probably still more congested Queensborough Bridge. The latter structure was planned for a maximum 12-hour traffic of 50,000 vehicles, but is often crossed in that period by more than 100,000.

Since it was put in service on July 11, traffic over the Triborough Bridge system has attained a maximum weekday volume in excess of 32,000 motor cars and trucks, which is representative of regular and not sight-seeing users. The combined crossings have been designed to accommodate, without congestion, 20,000,000 vehicles yearly, or 54,800 in a day—the estimated maximum likely to develop in the course of 25 years. Their capacity is controlled by the capacity of the approaches, and their spaciousness has been prescribed by the amount of money that could be reasonably expended in purchasing the necessary property—due regard having been given to the already upbuilt adjacent neighborhoods and to the existing tributary thoroughfares.

The system will be maintained and amortized by the tolls charged for different types and sizes of vehicles; and the plan is to wipe out the present debt before the end of 1958. The City of New York and the Triborough Bridge Authority are conjointly responsible for the total outlays, as follows: \$8,400,000 for land for the bridges,

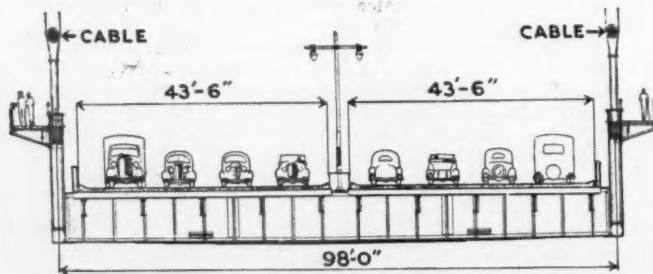
per se; \$23,400,000 for the construction of the bridges; \$15,300,000 for land for highway approaches; and \$13,200,000 for the building of the approach highways.

The Triborough Bridge system, aside from its immediate approaches and intermediate connecting viaducts, is composed of a suspension span across the East River; of a lift span across the Harlem River; of a fixed span across the Bronx Kills that may eventually be transformed into a lift span should traffic on that subsidiary waterway so warrant; and of a fixed crossing over Little Hell Gate, a non-navigable body of water between Wards Island and Randalls Island which lie between the three boroughs and sustain a large part of the bridge system. The approaches and the viaducts have a combined length of 13,500 feet, and they have been designed so that the prevalent grade does not exceed 3.6 per cent, although certain underpasses and detours have required grades of 5 and 6 per cent.

What might properly be called the key feature of the project is the great monumental 3-way intersection of concrete erected on Randalls Island. It is at that point that the Manhattan branch of the system joins at right angles the north-and-south route between the Bronx and Queens. This immense and seemingly complicated structure makes it possible for traffic to move to and fro between or among the boroughs without recourse to left turns or the interception of any of the traffic streams that may be traveling in opposite directions or at right angles. The toll booths, placed at strategic points on the intersection, deal with traffic in such a way as to require vehicles to stop but an instant when passing the collectors. With this outline of the layout it will be easy to understand the functions of the crossings.

The East River suspension bridge consists of a central span, 1,380 feet long, and of two side or approach spans each 704 feet 8 inches in length. The channel span affords a clearance of 135 feet between the underside of the floor and the surface of the river at high water. The two towers, which hold the suspension cables aloft, rise to a height of about 316 feet above mean high water and are topped by aerial beacons equipped with powerful electric lights. Each tower has two legs which are cruciform in plan; constructed of a series of rectangular cells fashioned of plates and angles of silicon steel; and tied together by great horizontal cross braces of carbon-steel plates and angles. The interval between each pair of legs is wide enough for two 43½-foot roadways. These are separated centrally by a curb island; are flanked at each outer side by a substantial steel barricade more than 3 feet high; and each carries four lanes of traffic.

The towers are set well in from the water's edge and rise from massive supporting piers that have their footings in the underlying bedrock. The two suspension cables are each 20½ inches in diameter; are composed of 9,176 separate wires each—the individual wires being 0.196 inch in diameter; and pass over the top of each tower 98 feet apart. The suspender cables sustain a floor system made up fundamentally of a series of transverse plate girders that are 96 feet 8 inches long and 4½ feet deep. The girders are of silicon steel; and upon them are set longitudinal stringers upon which rest lighter cross beams that immediately support the 7-inch concrete slabs that form the pavements of the roadways. Several feet above and at each side of the floor system there is a sidewalk 5½ feet in width. The suspension cables are

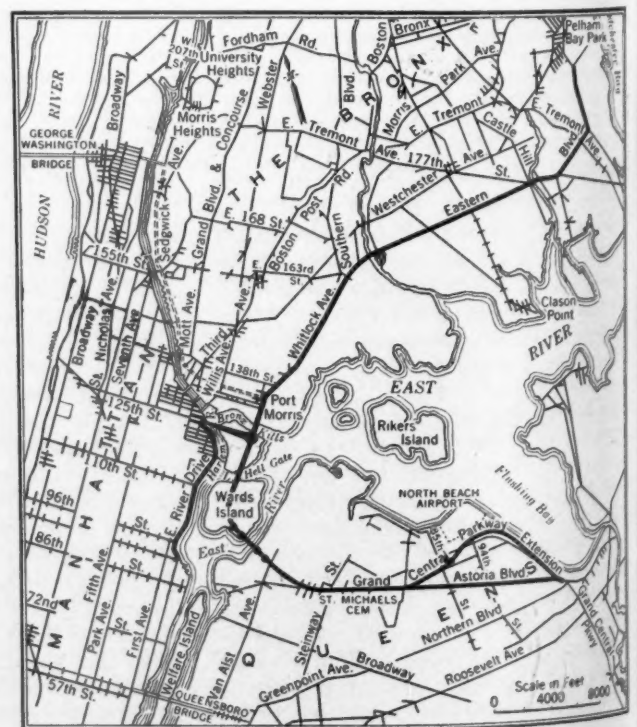


SECTION OF ROADWAY

The two 4-lane roadways are separated by a central curbing. The bridge is designed to carry 54,800 vehicles a day. More than 57,000 used it on the Sunday following its opening, and an average of 31,770 a day crossed it during the first month it was in service.

THE BRIDGE AND ITS CONNECTIONS

With the center of New York's 7,000,000 population near its location, the new bridge was sorely needed to expedite travel among the boroughs of Queens, Manhattan, and the Bronx. An extensive system of wide connecting highways has increased the usefulness of the bridge many fold, as the map at the right shows. At the lower left is shown the location of the Queensborough Bridge, hitherto the nearest fixed crossing to Queens for vehicles traveling from upper Manhattan and the Bronx. The map is reproduced from the magazine "Civil Engineering."

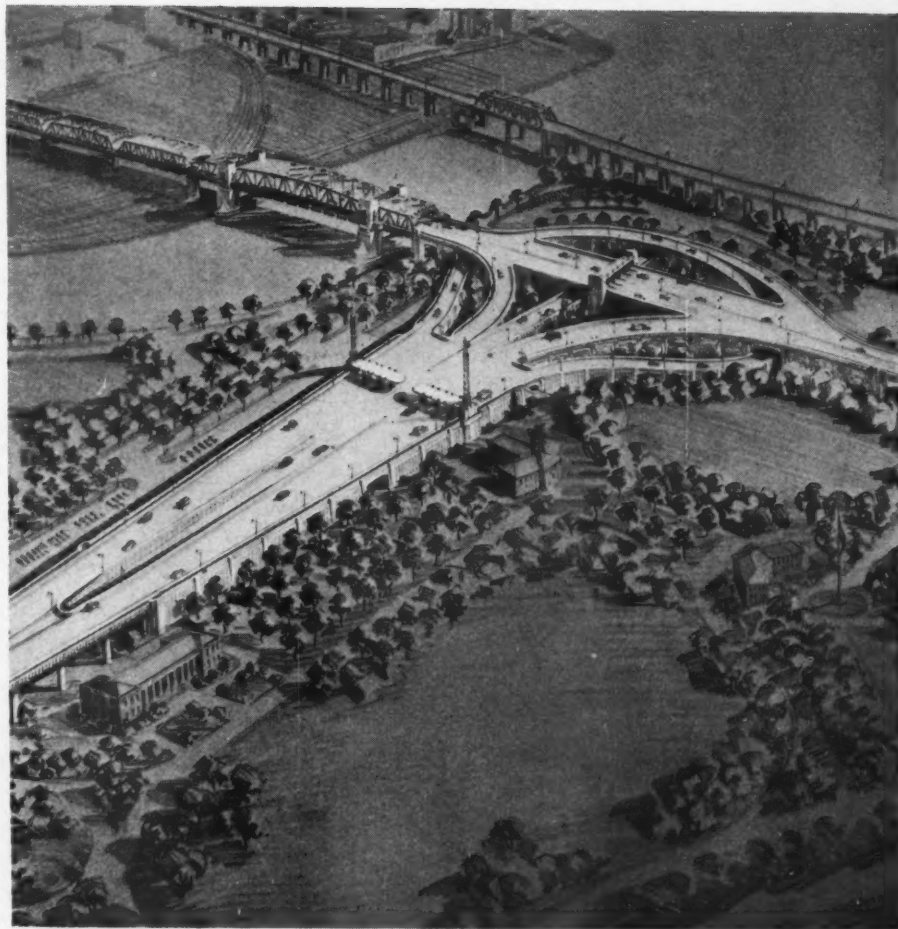


tied at their shore ends to two massive anchorages which, in their turn, are bonded with the bedrock and are designed to absorb both the dead load and the changing live loads of the bridge under varying service conditions. Elevated viaducts, sustained by numerous firmly planted piers, cross Wards Island and Randalls Island, and in the gap between the two islands piers have been carried down underwater to satisfactory footings.

Bronx Kills is spanned by a fixed 3-truss bridge that is designed, as already mentioned, for possible conversion into a lift bridge should water traffic on that stream justify the change. The Manhattan branch of the Triborough system crosses the much traveled Harlem River by way of a 3-truss span 772 feet in length—the central span being 310 feet long and arranged so that it can be raised a vertical distance of 80 feet. When lowered, the span clears the water by 55 feet, and when raised the clearance is 135 feet. On the basis of its floor area, the lift span, which is wide enough to accommodate eight traffic lanes and has two sidewalks, is the largest of its type yet built, although the recently constructed lift bridge over the Cape Cod Canal has a considerably longer span and a greater vertical movement. The Harlem River Bridge, with its two towers, each 220 feet high, is not only an architecturally fine structure but an outstanding example of the bridge-builder's art.

The unimpeded movement of traffic within the corporate limits of a populous community is no less essential to its well-being than the corresponding free flow of the blood in our bodies in prompt response to our diversified physical efforts. Topographical circumstances, in the form of waterways, have heretofore hampered traffic among the three boroughs in question; but the Triborough Bridge system is the engineer's and the far-seeing city planner's solution of the difficulty. A crossing between any of the two newly interlinked boroughs can now be made in a few minutes by vehicles traveling at a rate of 30 miles an hour; and it is said that the longest run which obviates the use of ferries across the East River will be shortened by half an hour.

To relieve congestion to and from the bridge in Manhattan there is being constructed the East River Drive along the west shore of that waterway for a distance of about $1\frac{3}{4}$ miles—extending northward from 92nd Street to 125th Street, which leads directly to the approach of the Harlem River Bridge. A cleverly designed intersection makes it possible for diverging traffic to enter and to leave the bridge without interfering with the diversified streams of vehicles. Boulevard connections in Queens and in the Bronx will enable people to reach easily and quickly the beach resorts of Long Island and similar places along the north shore of Long Island Sound or the hinterland in either case. Likewise, interborough traffic, whether for



THE HUB OF THE SYSTEM

The unique intersection on Randalls Island, showing how traffic moving to or from Manhattan at the lower left, the Bronx at the upper left, or Queens, towards the right, crosses and criss-crosses without interference, congestion, or hazard. From this point also diverges the roadway to Randalls Island, where a new municipal stadium has been erected at a cost of \$4,000,000. There are nine acres of roadway surface at this junction area. Its construction required 70,000 cubic yards of concrete, and 5,900 tons of reinforcing steel.

business or for pleasure, has already responded to the new route and will continue to do so as the tributary sections develop. In short, the City of Greater New York can now grow and make full use of her outlying areas as she was not able to do before the building of the Triborough Bridge system. Flushing Meadows Park, the site of the projected World's Fair to be held in 1939, lies to the eastward of the Triborough Bridge and is to be connected with the crossings by boulevards now being built.

In doing the work that has been brought to its present climax, compressed air and pneumatic equipment of different kinds have contributed to speed of construction and to the efficient performance of a diversity of operations. Rock drills have been used to prepare the sites for bridge-tower piers, cable anchorages, footings for viaduct piers, etc. The steel structural parts of the bridges have been set up in place with bolts and nuts secured with pneumatic impact wrenches; and then, after that preliminary erecting, the members have been permanently fastened by rivets driven tight with pneumatic hammers. Air-operated vibrators have com-

pacted concrete within the forms during the building of many of the features of the composite crossing; and much of the painting and aluminum coating of surfaces has been done by the spraying process. These are only some of the manifold services of compressed air on this big undertaking.

So many contractors have played a part in the consummation of the project that credit by name cannot be given here. It is enough to know that they have done their work well and expeditiously. The chief executive officer of the Triborough Bridge Authority is Robert Moses, and the administrative director is Col. Paul Loeser. The engineering staff consisted of O. H. Ammann, chief engineer; E. W. Stearns, assistant chief engineer; Allston Dana, engineer of design; J. C. Evans, engineer of approaches; Col. H. W. Hudson, engineer of construction; and E. Warren Bowden, assistant to chief engineer. Aymar Embury II was architect; and among the consultants were the following eminent technicians: Ash-Howard-Needles & Tammen, Leon S. Moisseiff, Daniel E. Moran, consulting engineers, and Charles P. Berkey, consulting geologist.

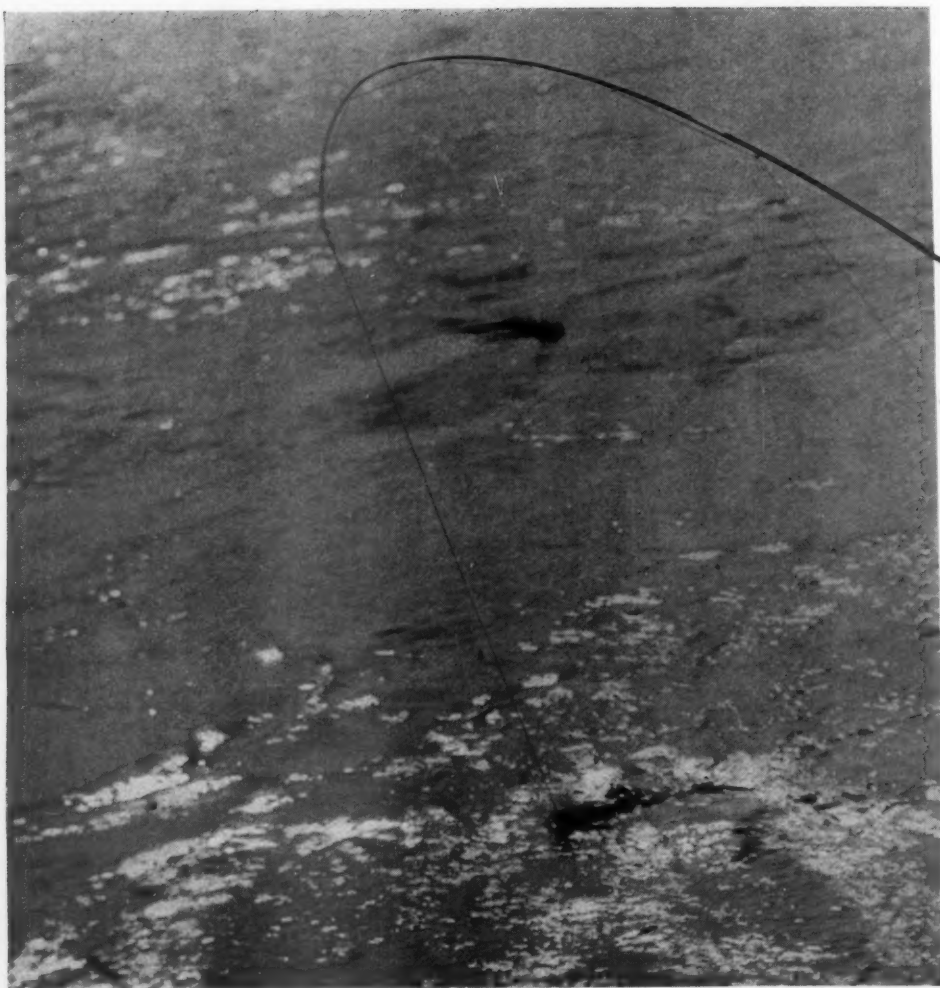


Photo from
National Parks
of Canada

FISHING FOR SALMON

The ouananiche, a land-locked salmon, is one of the gamest fishes that lives and is eagerly sought by sportsman who visit the Saguenay district. Organized fishing tours were formerly conducted by the railroad and steamship companies, but the coming of the automobile ended them.

The Kingdom of the Saguenay

George E. LaMothe

AS HAS been pointed out, the upheaval during the Tertiary period and the workings of the Lake St. John glacier made the Saguenay region of the Dominion of Canada one of the biggest and most economical water-power centers of the world. Lake St. John in its main watershed, and one of the largest natural reservoirs on the continent, Lake Kenogami at the head of the Chicoutimi and au Sable rivers, lakes Pamascajou and Onatchiway on the Shipshaw River, and lakes Bouchette and des Commissaires on the Ouiatchouan—all these storage basins give a very enviable, regulated flow of more than one second-foot per square mile of drainage area. This, coupled with a fall in excess of 300 feet in about 20 miles of the Saguenay River, 500 feet or so in the stretch between the latter and Lake Kenogami, and 500 feet within a very short distance along the

This is the second of two articles on this subject by Mr. LaMothe.

Shipshaw, has permitted the construction of power projects at an initial capital cost ranging from below \$50 to \$100 per horsepower, which is exceptionally low.

About 850,000 hp. has been developed. Most of this is used in the Saguenay region by the different paper mills and by the aluminum plant at Arvida, the surplus being transmitted to the St. Lawrence Valley and consumed between Quebec and Montreal. However, when work on partially developed power sites is completed, the total output will amount to some 1,500,000 hp. The undeveloped water-power resources are extensive—sufficient, it has been estimated, to provide another block of 1,500,000 hp. Most of the streams flowing into Lake St. John have huge drainage areas. The Peribonka, alone, has a watershed nearly as big as that of the St. Maurice and a 500-foot drop capable of economical development. Then there is the Mistassini with an equally large watershed, as well as



the Achampchouan, which has a drainage area of more than 5,500 square miles.

The existing hydro-electric plants in the Saguenay country make an impressive showing, and are as follows:

LOCATION	INSTALLED HORSEPOWER
Isle Maligne.....	540,000
Chute a Caron, when fully developed.....	800,000
Kenogami Mill.....	26,200
Jonquiere.....	2,500
Jonquiere Mill.....	4,500
Chicoutimi.....	10,500
Chicoutimi.....	10,870
Chicoutimi Mills.....	9,350
Pont Arnaud.....	7,200
Chute Garneau.....	3,500
Chute Murdock.....	10,800
Chute des Galets.....	17,600
Bagotville.....	1,350
Ha! Ha! River.....	1,300
Ha! Ha! River.....	800
Oniatouchan.....	7,300
La Martine (Metabetchouan).....	1,400
	1,455,170

Add to this total the numerous stations built for the operation of grist mills, saw-mills, and for the electrification of small municipalities, which account for another 2,000 hp., and you have a comprehensive picture of the water-power situation. Most of the latter plants can draw upon a regulated flow, and if not, are located where storage can be created at low cost, as required.

Now for the timber resources. The history of the forests in northeastern Canada seems to be about the same everywhere. To fully understand it one must go back to the years before the migration of man from Asia to America by way of Bering Strait and after the Champlain Sea had receded. Imagine a soft-wood forest of spruce, balsam, and jack pine with a small percentage of hard wood. It grows, comes to maturity, declines, and immense gaunt, dry spars remain to invite lightning. One is struck; and

the fire that ensues burns down the trees. Decades go by; and hard woods come up probably from latent seed in the ground. These are followed in a few years by soft woods which thrive under the shelter of the standing timber and soon become so strong and dense that they kill, little by little, the protectors of their early days—the hard woods. Then the cycle, which takes from 100 to 200 years to complete, repeats itself. In the case of black spruce, and in flats where drainage is lacking, the rotation may vary somewhat; but generally it is much as described.

With the advent of man—first the Indian—nature pursued its own course for a while. As population increased, tribes were formed and territory was allotted to the different ones. When a tribe found that there was not sufficient hard wood on its land to provide it with the necessary moose and deer, it sometimes made up the deficiency by burning down a stand of soft wood, thus obtaining results probably just as quickly as by going to war against a

neighboring tribe. The same procedure was followed in the mossy regions of the caribou. The blueberry is a delicacy the Indian as well as the white man relishes; and a fire in a green forest will give a fine crop in two years' time. When the white man came with his agriculture and industry he undoubtedly was more destructive in this respect than both nature and the Indians; and, what is more, his conflagrations, unlike theirs, gave no returns. In his *Relations of the Jesuit Fathers*, Father Crespeuil, who traveled up the Shipshaw River—a tributary of the Saguenay—in 1673, tells about an immense new burn below Lake Onatchiway. This area was cut over for large saw logs probably around 1860; for smaller saw logs up to about 1900; and eventually for pulpwood between 1919 and 1933.

Today, the Saguenay forests present a different picture. Just what the more than 30,000 square miles of timber land constitute and what they can be counted upon to yield annually are questions that are difficult to answer, as no official figures are



INDUSTRY IN THE HOME

A typical "habitant" kitchen in the Saguenay district, where French-Canadian house-wives and their spinning wheels, busily employed during spare time, contribute substantially to family incomes.

SUNSET ON THE SAGUENAY

Canadian National Railways Photo



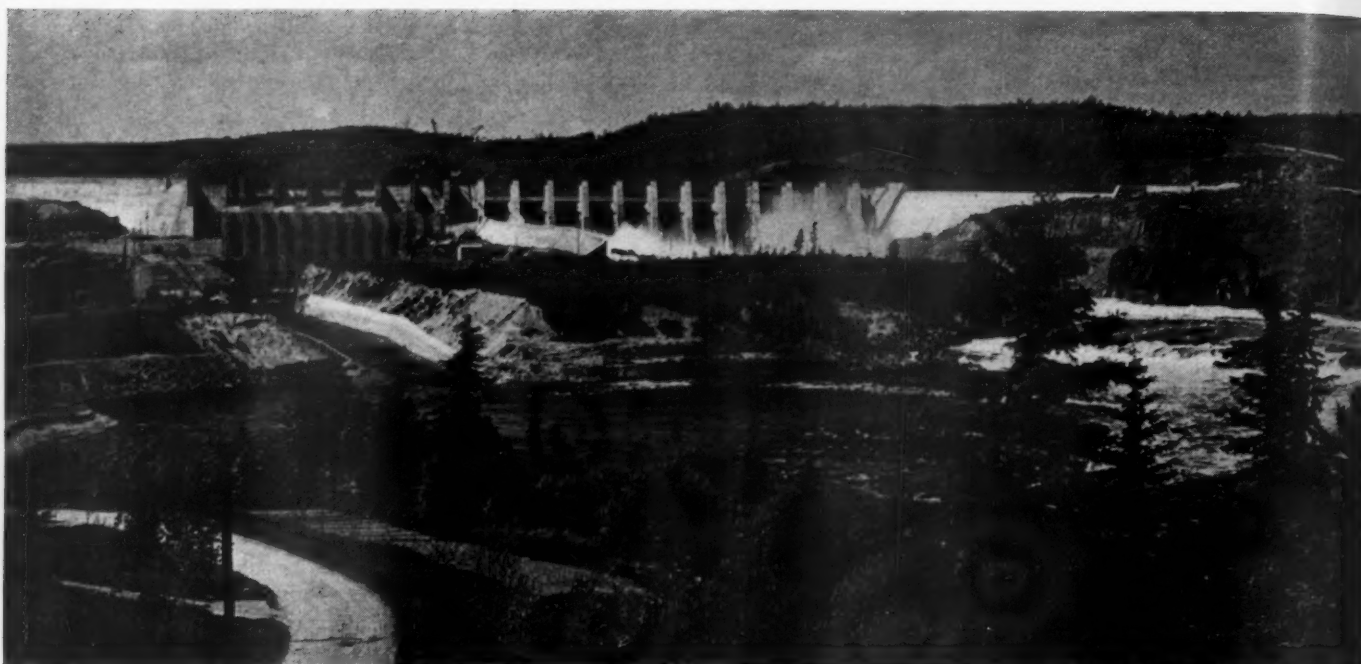


Photo from Electrical News and Engineering

CHUTE A CARON

This hydro-electric plant of the Alcoa Power Company at Arvida generates about 260,000 hp. It utilizes only a small part of the flow of the Saguenay as it comes down the glacial gorge from Lake St. John, some 20 miles away, and it is

estimated that when completely developed it will produce 800,000 hp. It operates under a head of 160 feet. The energy is consumed in the Arvida plant of the Aluminum Company of Canada, Ltd., for the manufacture of aluminum from bauxite.

available. In Canada, at least in the eastern part, forestry is not an industry as it is in Europe. This can perhaps be better explained by comparing the prevailing practices.

Abroad, the owner of such lands cuts down the different kinds of trees that have reached a stage to warrant it. A certain proportion of his timber may, for example, be suitable for pulpwood, another for charcoal, some for sawn lumber, and so on, and each is sold to the particular industry that utilizes it. In the Dominion, on the other hand, the circumstances, generally speaking, are reversed. If a man owns a sawmill he usually has stands from which he cuts only logs that are suitable for lumber. Paper companies own immense tracts that will supply them with necessary pulpwood and, as a rule, nothing else. One cannot, therefore, expect to get the same yield in both cases. However, there are sound and sufficient reasons for the Canadian methods, and they will probably be continued for years to come.

With these facts in mind, it can be broadly stated that the Saguenay forests mainly serve the cellulose industry. Hard woods shall be ignored for the present, although poplar and birch can be and have been pulped. The hard woods are considered weeds; and as the forests are generally situated beyond the fringe of civilization, wood of this kind cannot even be used as fuel because of the prohibitive cost of transportation. In Sweden, on the other hand, the forests—which serve much the same purpose as they do in Canada—are within easy reach of populous centers, and there the hard woods are a by-product; they are

cut at a profit for the heating of public buildings. Aside from reducing operating costs, this removal of the trees not fit for pulpwood is desirable from the silvicultural point of view.

Assuming that all the timber will be employed for pulping purposes, let us see what is the present-day status of the Saguenay forests. If we divide them roughly into mature stands, young stands, and new burns, we find that the first, if cut in time, will take about 75 years to yield merchantable pulpwood again; the second may require perhaps 40 years before they are ready for cutting; and the third will probably not supply timber suitable for pulpwood for from 100 to 125 years.

In the memory of man, the Saguenay country has been cut over twice, the elapsed time between cuttings being 40 years. In Father Crespeuil's case, mentioned at the beginning of this article, the natural cycle covered 200 years. However, we must not forget that we are now speaking in terms of pulpwood. William Price's lumberjacks, who cut over the Shipshaw area in which the stands were overmature, were interested only in logs that yielded 14 inches at the end of 16 feet, while pulpwood operators call anything merchantable that will yield 4 inches at the end of a 13-foot log. This is held to be correct, although it may not be considered so from the European standpoint. But this is another story, and too long to discuss here.

As may well be appreciated, it would take a lot of data even to approximate the annual forest increment. However, we do know that the soil is good for silviculture; and it can be stated without fear of contra-

diction that the increment would amount to at least 2 per cent—that is to say, the Saguenay could be expected to yield each year a crop of 400,000,000 cubic feet of pulping material. If we analyze these figures we come to the conclusion: first, that this is enough pulpwood to supply all the newsprint mills in Canada if they were running at full capacity; second, the newsprint produced would be sufficient to furnish all the Americas with newspapers morning, noon, and evening, including extras and Sunday editions; and, third, that the Saguenay could be depended upon to provide half the world with newsprint.

But what about power to convert this pulpwood into newsprint? As we already know, the region's resources in this respect are ample for the purpose. And this is true, because it would take approximately 1,250,000 hp., and nearly that much is being generated by the existing wheels at the present time, with plenty more energy available for economical development. But enough of idle figures: they are simply given to show how great are the pulpwood potentialities of the Saguenay. There is no thought of anything approaching this production, because there are many other places in eastern Canada where there is as much pulpwood, even more.

With this knowledge of the forest riches, let us see what advantage industry has taken of this natural resource. The sawmill industry is small: spool wood probably is its principal output, and the quantity exported is not very large. The cellulose industry, on the other hand, is important, as the following rough inventory of the local mills indicates:



NEWSPRINT MILLS	DAILY CAPACITY
Dolbeau.....	300 tons
Riverbend.....	500 tons
Kenogami.....	600 tons
Port Alfred.....	500 tons

Total.....1,900 tons

GROUND-WOODPULP MILLS	DAILY CAPACITY
Chicoutimi.....	350 tons
Val Jalbert.....	100 tons

Total.....450 tons

Sulphite mill at Desbiens.....50 tons
Board mill at Jonquiere.....60 tons

This amounts to a production of 2,460 tons a day and calls for about 80,000,000 cubic feet of pulpwood annually, or considerably less than the region is capable of supplying. Even so, the mills' possible newsprint output represents more than 60 per cent of all the paper manufactured in the United States and approximately 20 per cent of that produced in Canada. All the plants are modern, the one operated by Price Brothers boasting the newest thing in paper-making machines—the vacuum or Minton type.

Also of industrial importance is the great aluminum reduction works created at Arvida by American interests. Inside of five years the company developed more than 1,000,000 hp. on the Grande Discharge; built the plant, the model City of Arvida, and a railway or two; and improved a deep-seaport. The necessary raw material, bauxite, comes from South America; and the output of aluminum, probably in excess of 30,000 tons a year, is exported to all parts of the globe.

With industry running at full capacity in the Saguenay, the aggregate freight to

be transported by rail, water, and highway reaches something like 1,000,000 tons annually. This represents outgoing shipments: the incoming perhaps not totaling more than 400,000 tons. By water, the region is in touch with the entire world. It has two modern harbors, Port Alfred and Chicoutimi, where the variation in tidal flow is as much as 20 feet. Railway communication with the other sections of Canada is effected by the Canadian National; but grades are heavy and routes roundabout. Any expansion of industry in the region which would increase especially the incoming traffic would certainly ameliorate conditions because it would warrant railway expansion, shortening hauls, and reducing grades and, of course, freight rates. Today, the run from Chicoutimi to Quebec by rail is about 225 miles, and the grades, as just mentioned, are not easily negotiable. It would be possible to construct a line of standard grade between those two points with 40 per cent less mileage! As most of us know, however, Canadian railways were not built to shorten distances, but to open up new country.

As the geological formation of the Saguenay consists largely of sand, gravel, and clay, it has permitted the construction of miles of gravel roads at low cost. They cover all the inhabited areas, which is not the case elsewhere in the Province of Quebec. While they may have their disadvantages, they get the people there, and they take great pride in them. The principal cities are connected by bituminous roadways; and for the past eight years two automobile highways have linked the region with the remainder of the province. A

third and much shorter one is soon to be opened to traffic, and will, to that extent, facilitate intercourse.

Just at present a war is being waged in the transportation field, with the Saguenayans on the one side and the people from Abitibi on the other. It happens that the owners of rich ore beds in Chibougamau and Opemiska are looking for an outlet. The former want this traffic to go down the Saguenay River, which is only 150 miles or so away, while the latter argue that it should be transported an equal distance in the direction of Montreal to the Canadian National in their district. The Saguenayans offer power, tidewater, and an agricultural area than can provide food for many more mouths than it does today, while Abitibi, seemingly deficient in these respects, offers its ore-treating facilities as an inducement.

Talking as we have in millions, what about the butcher, the baker, and the candlestickmaker? Fur-trading, the Dominion's oldest industry, is still practiced in the Saguenay. The Montagnais roam the forests we have been describing. They have a reserve at Pointe Bleue near Roberval on Lake St. John to which they return every summer. Some 75 Indian families live there with probably as many half-breeds. The same tribe has another reserve at Bersimis, situated on the St. Lawrence, and hunts in the headwaters of the Saguenay. Both groups frequently change their summer camps if pressed too hard by their financial backers at the respective reserves. Crees from Lake Mistassini on the Hudson's Bay watershed, where Doncona's pygmies were supposed to have dwelt, often come to

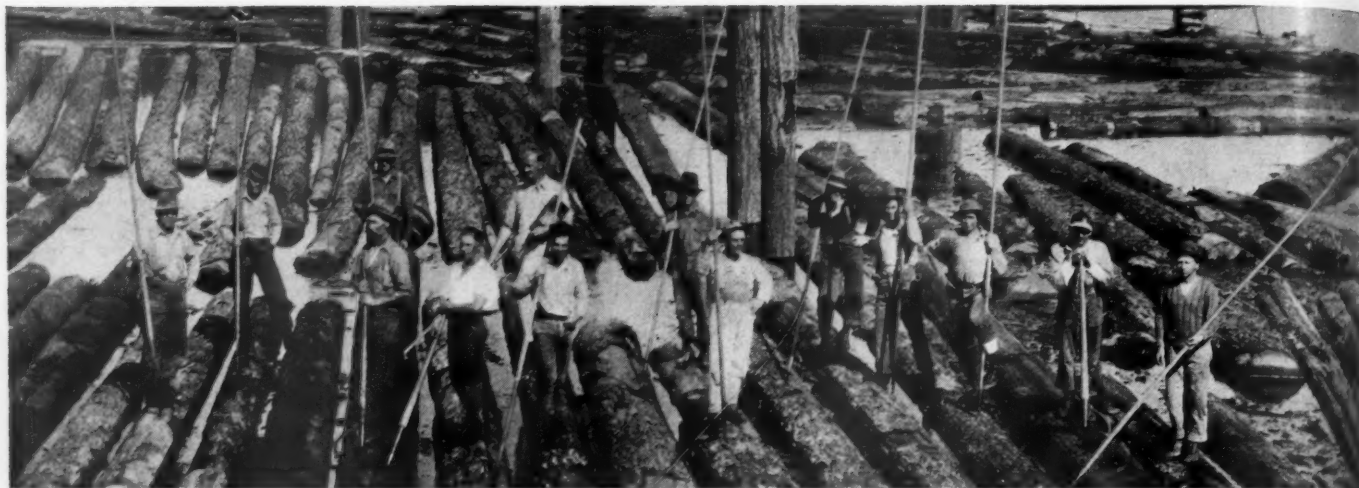


Photo from Electrical News and Engineering

ISLE MALIGNE

This station of the Saguenay Power Company on the Grande Discharge from Lake St. John has installed capacity for producing 540,000 hp., which ranks it among the large power plants of the world. It operates under a head of 110 feet and

the flow is well sustained by the enormous storage capacity of Lake St. John. Current is generated at 13,200 volts and is then stepped up to various higher voltages for transmission to industrial plants in the district, and to Quebec City.



CANADIAN LUMBERMEN

This picture was taken in British Columbia, but the group may well contain some Saguenayans, for the latter are among the most skillful lumbermen in the world, and they roam far

and wide following their calling. Always, however, they return to their native Saguenay periodically. The men shown here are making up log booms.

Pointe Bleue to see something of civilization. The old voyageur spirit still persists in the Saguenay. Scratch beneath the surface of a real Saguenayan and you will always find a hunter and, like as not, a poacher. And the best guides and canoe-men in Canada can be found there.

Under normal conditions the country's revenue from furs is more than \$100,000, excluding the pelts obtained by fur-farming. However, this figure has decreased considerably of late years because of a reduction not only in prices but in catches. But, fur-trading, with the lifting of the depression, is showing signs of improvement. Fox-farming was badly hit but is coming back; and one of the finest mink ranches in Canada flourishes near Chicoutimi where the climate is especially suitable for it.

Earlier in this article there was a reference to blueberries in relation to forestry. This fruit plays something of a part in the economic life of the Saguenayans—so much of one in fact that they are nicknamed "Blueberries." It is estimated that a crop worth \$500,000 and more was exported annually before the days of hard times. In late summer, whole families will migrate to newly burned over forest areas. With some it is a real business. Take one man in particular, who supplies blueberries to a steamship company. He burns over a section of his wooded lot each year to assure a profitable crop.

Besides the usual run of small industries in the Saguenay there are a few enterprises that bear the hall mark of distinction. A spinning mill in Chicoutimi makes fine homespun from wool produced locally. The operation of this plant was not affected by the depression. A blacksmithshop in the same town manufactures ornamental forged iron that rivals Belgian work, while a shoe-pack (sort of moccasin) factory turns out the most comfortable kind of boot for hunting and fishing. There are at least two furniture factories in the region that export,

and also a factory that makes canoes for expeditions, not the summer-resort variety.

Strange as it may seem, the advent of the automobile adversely affected hunting, and, particularly, fishing. Previously, the railway owners had built a chain of hotels on Lake St. John. Sportsmen used to leave Quebec by train and go as far as Roberval, where they would remain a day or so and then cross Lake St. John by steamer. At its outlet on the Grande Discharge they would spend a few days fishing the gamest creature in the world—the ouananiche—a land-locked salmon, probably a survival of the Champlain geological period. Having fly-fished to their hearts' content, guides would take them in canoes down to Chicoutimi 30 miles away, shooting the rapids along the way—another thrill. The return voyage thence by steamer, and a real and delightful tour of the Saguenay was concluded. All this is now a thing of the past.

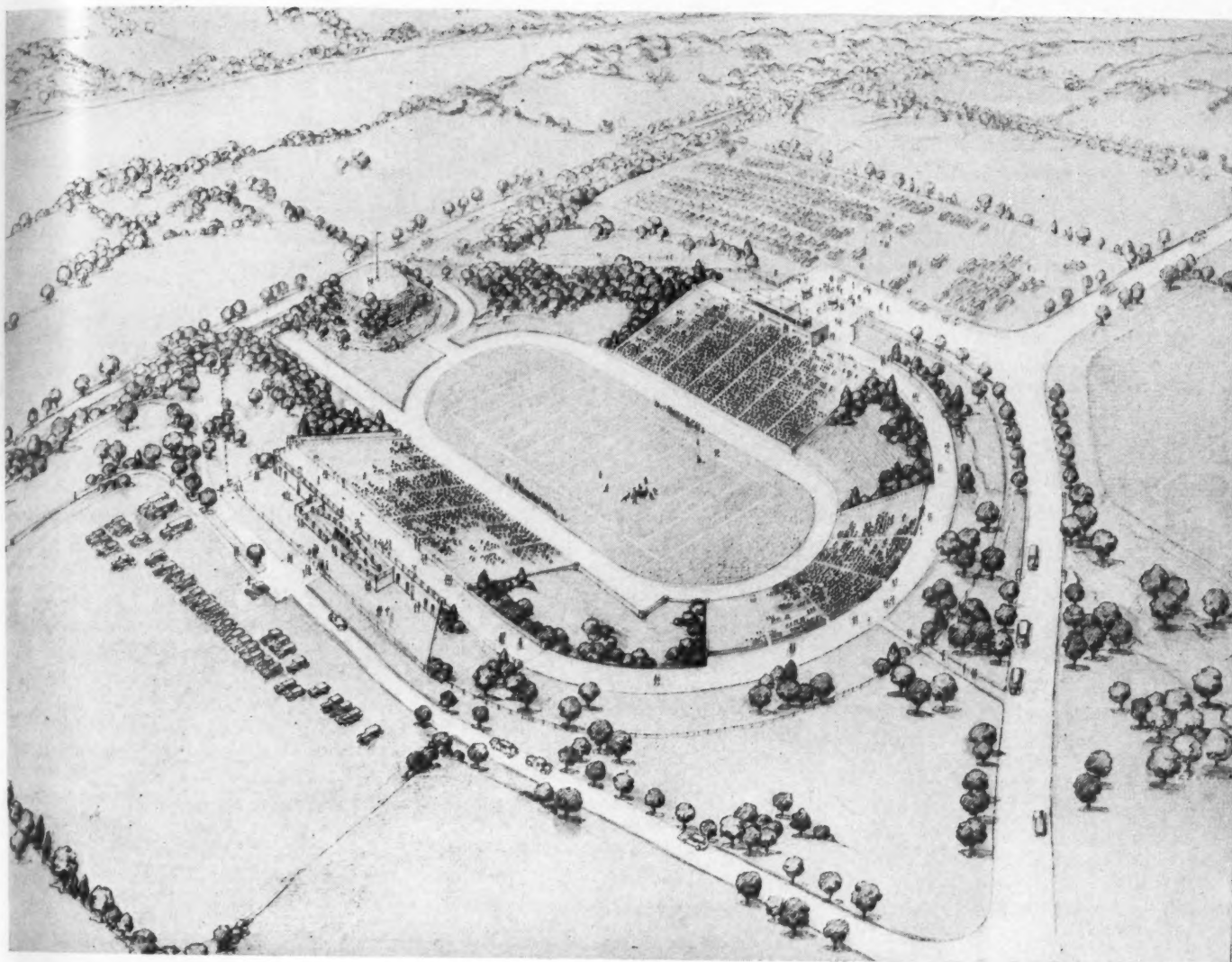
Needless to say, most of the lakes, rivers, and streams are stocked with fish. Besides ouananiche are found trout, pike, and dore. Salmon likewise is caught in the small waterways tributary to the Saguenay. Moose and caribou are numerous, the former having migrated north of the Saguenay River but a relatively short time ago, and deer are beginning to appear. Partidges, geese, ptarmigan, and ducks are plentiful—in short, the country is a hunter's paradise.

Except for private preserves and the government national park south of Lake St. John, fish and game are more abundant in the hinterland than they are close to the inhabited areas. It is to be hoped, however, that the government will take measures to preserve animal life there, constituting as it does a natural resource that helps to attract tourists, who are a potential source of revenue. In Laurentide National Park, where the government has been concentrating its efforts, splendid fishing is to be had, and the sportsman who may spend a

week there in quest of it will be unlucky indeed if he does not see moose, bears, beaver haunts, etc. In addition to this park, two days' easy canoeing north, south, or west, will bring him to ideal fishing territory.

It has been the opinion of many economists that big industry, such as exists in the Saguenay, should be counterbalanced by small industrial enterprises. The region offers opportunities for them, especially for concerns that can sell their products to the big industries and to the inhabitants. The trouble has been that the Saguenayans have grown accustomed to think in terms of companies. Any new business venture, therefore, had to be a company even if the money invested amounted to only \$10,000 and was owned, let us say, by a score or more of persons. The result has been failure for two reasons: first, liquid assets entered into the small capital structure and, second, technicians had to be hired because the shareholders knew nothing about the new enterprise. This, generally speaking, is the story of most of the attempts that have been made in this direction. The industries that have succeeded have been those that were owned and operated by one person and that had as little resemblance as possible to a company with a board of directors.

From the foregoing it is not difficult to arrive at the conclusion that the Saguenay has a promising future. However, isolated as the country is, there will be difficulties along the way. For one thing, agriculture must catch up with industry. This balance cannot be achieved by increasing the area now under cultivation for, as has been brought out previously, very little unsettled arable land remains in the region. What is necessary is increased yield and, hence, profit per acre through education—in other words, agriculture must be made sufficiently attractive so that its ranks will not be depleted to swell the industrial army that is already overcrowded.



ARCHITECTURAL STUDY OF STADIUM

The development is being planned with an eye to beauty as well as utility, and the proposed treatment will be in harmony with the natural setting. The stands shown here will seat 22,830 persons. Future additions, to be made as required, will increase the capacity

to 50,000 persons. The field house is shown behind the stands at the left. The structure on top of the opposite stands will include a press box and platforms for taking pictures. There will be 20 acres of parking spaces, sufficient for 4,000 cars.

Athletics for All

To Make This Possible at Rutgers University, Outstanding Outdoor Facilities are Being Built

C. H. Vivian

RUTGERS University, the state university of New Jersey, located at New Brunswick, is constructing an outdoor area for physical education that is designed to provide athletic facilities for the entire student body for at least 50 years to come. It will be probably the first complete athletic plant in connection with an American university to be planned in advance and to be built all at one time. Many colleges have elaborate athletic plants, but almost all of them have been assembled piecemeal, additions having been made as they were required and as funds for them became available. The result is that, like a house

that has been enlarged from time to time, they may be serviceable, but are lacking in certain respects as compared with a structure that was originally projected to meet future as well as present needs.

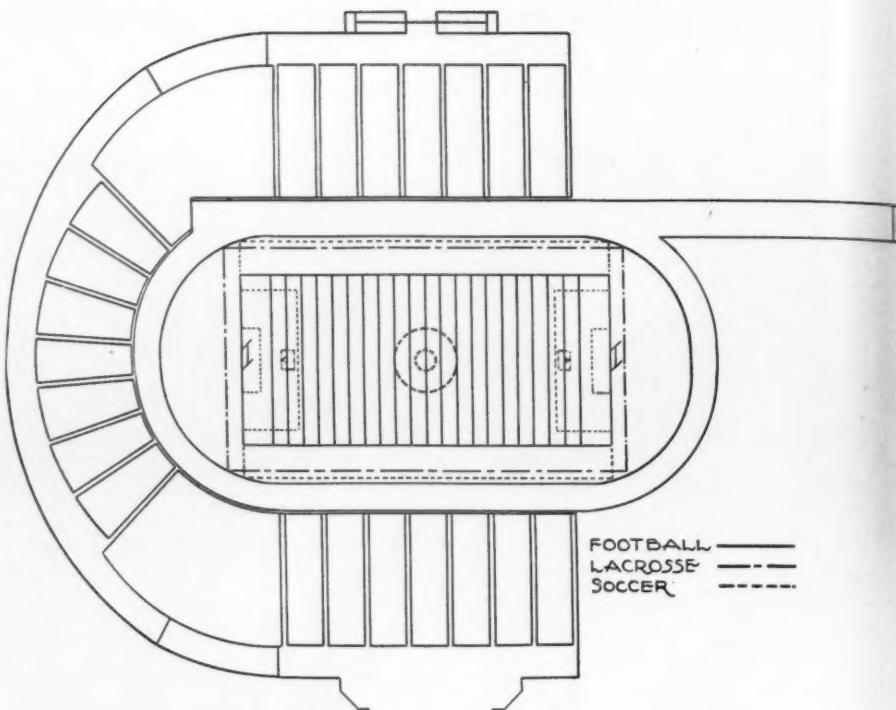
The movement at Rutgers will have the approval of those persons that believe colleges have been over-emphasizing football and that there has been a tendency toward striving to turn out eleven gridiron supermen rather than to improve the physical condition of the average student. This criticism is not a fair one as applied to the general run of schools, of course, and the mere fact that a college produces a winning

football team with considerable regularity does not prove that it slights intra-mural athletics. It is well known, however, that there are rich rewards in the form of gate receipts and publicity to be reaped from putting forth a contender for national football honors and these have sometimes tempted college authorities beyond their limits of resistance.

One outward expression of this trend has been the mania for constructing huge stadiums. In order to enrich the collegiate athletic coffers it has been necessary to provide playing fields with large seating capacities. Some of the numerous struc-

tures erected during the decade prior to the depression cost as much as \$1,500,000 each. Once they were in place, they had to be paid for, and football was expected to foot the bill. Under such conditions, a winning Varsity team became an economic necessity.

The authorities at Rutgers are not taking the attitude of reformers. In fact, they contend that football plays a valuable part in the whole scheme of undergraduate life, and there is no evidence that the school intends to abandon its traditional policy of trying to put a strong team on the field each fall. At the same time, they recognize that the athletic program should have balance and they are trying to achieve that balance by providing playing fields of diversified characters that will permit all who will to take part in athletic games of their own choosing. The central feature of the plan will be the football field where public



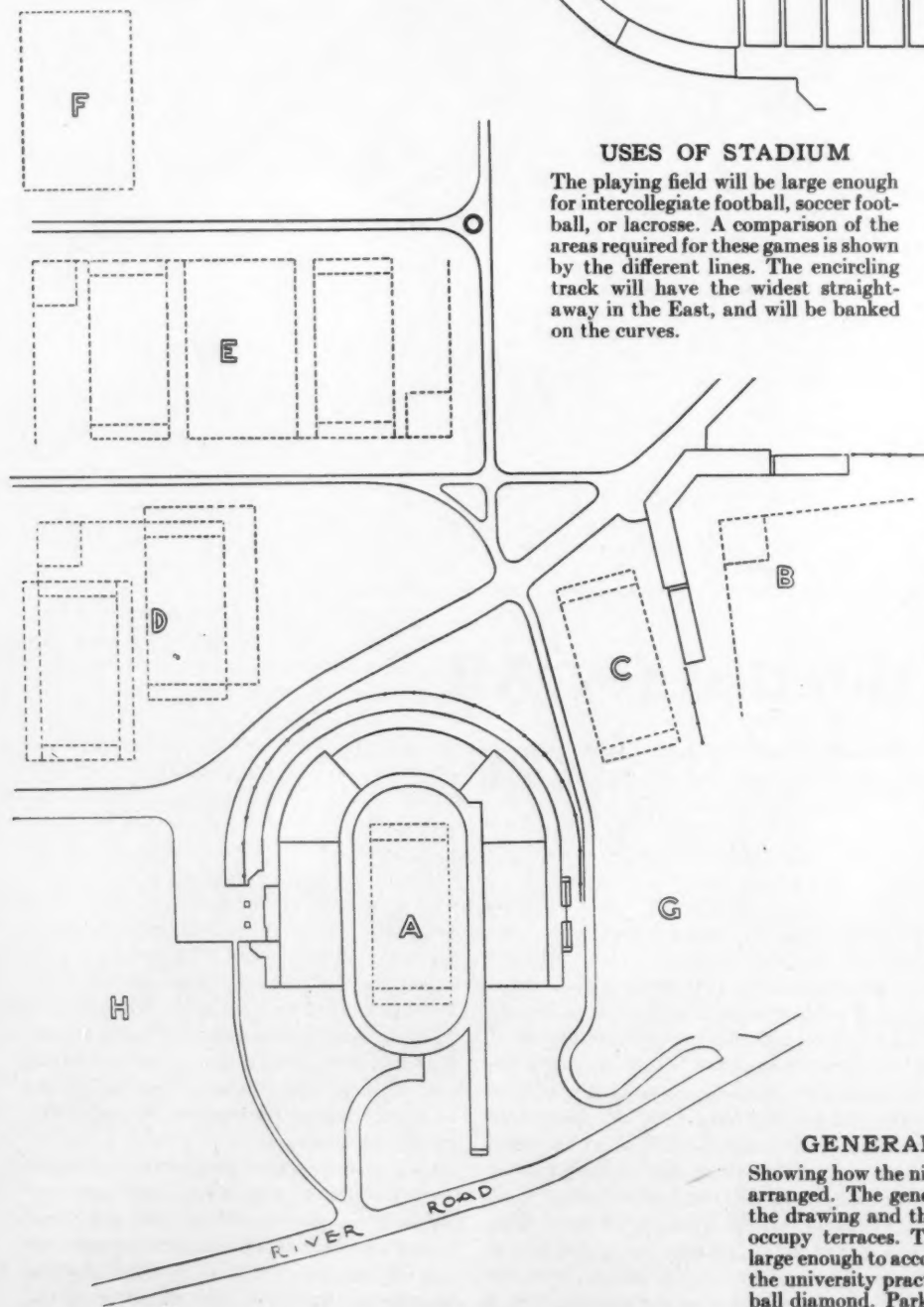
USES OF STADIUM

The playing field will be large enough for intercollegiate football, soccer football, or lacrosse. A comparison of the areas required for these games is shown by the different lines. The encircling track will have the widest straightaway in the East, and will be banked on the curves.

exhibitions will be held. But grouped around it, and greatly exceeding it so far as space is concerned, will be additional fields for the playing of intercollegiate, rugby, and soccer football, as well as baseball and lacrosse. The main football field will be laid out so that it can also be used for track and field meets, and it will also be the finishing point for a 5-mile course for cross-country runners. In addition to these provisions, the area will be combined with a 9-hole golf course which is already in use.

The procedure that has been followed in planning these facilities seems so sound and effective that it has led to the suggestion that a new profession that might be termed "athletic engineering" will very possibly develop in the future. There can be no argument as to the economic advisability of spending ample time to make a thorough study of what should be done and how to best do it. As evidence in support of that statement we may cite the fact that the estimated complete cost of the entire Rutgers development, including the land, will be approximately \$650,000. When it is considered that this will provide not merely a place where the public can watch competitions in various sports, but also facilities that will enable the entire student body to gain wholesome exercise throughout most of the school year, the expenditure seems very modest indeed.

Before a shovelful of dirt was turned at Rutgers, a year and a half was spent in



GENERAL PLAN OF DEVELOPMENT

Showing how the nine gridirons and four baseball diamonds will be arranged. The general slope of the land is towards the bottom of the drawing and the intra-mural fields "F," "E," and "D," will occupy terraces. The plot marked "E" will be 1,000x500 feet, large enough to accommodate four gridirons. The area "C" will be the university practice football field and "B" the exhibition baseball diamond. Parking spaces are designated by "H," and "G."



CHANGES MADE IN RAVINE

Nature did part of the excavating for the stadium, runoff water having eroded a ravine that is being widened and deepened to form a sunken bowl. The view at the left shows the site as it appeared last November, when work started. At the right is a picture made from

the same point on August 27, when excavating was about 60 per cent completed. The area in the left foreground where the trucks stand is down to final sub-grade. Approximately 170,000 cubic yards of dirt and rock will be removed.

study and planning. The Federal Government cooperated in this work by lending the services of a group of architects, engineers, and draftsmen who were employed on public works activities in the vicinity. The investigations were headed and directed by George E. Little, director of physical education at Rutgers, and Clifton V. Barrett, engineer of outdoor athletic development at the school.

Some of the conclusions reached are of general interest and will no doubt be valuable to other schools when they come to recast existing athletic layouts. It was found, for example, that the life of such fields averages about 50 years and that new facilities should accordingly be built to last no longer than that. Because the popularity of a certain game may wane, or games that are now of secondary interest may become leaders, it was decided that the principal exhibition field—nowadays the conventional football field—should be built with such dimensions that it could readily be adapted to other sports. Translated into practical layout, this means that ample room should be provided for transforming the football gridiron into the somewhat larger fields required for lacrosse and soccer.

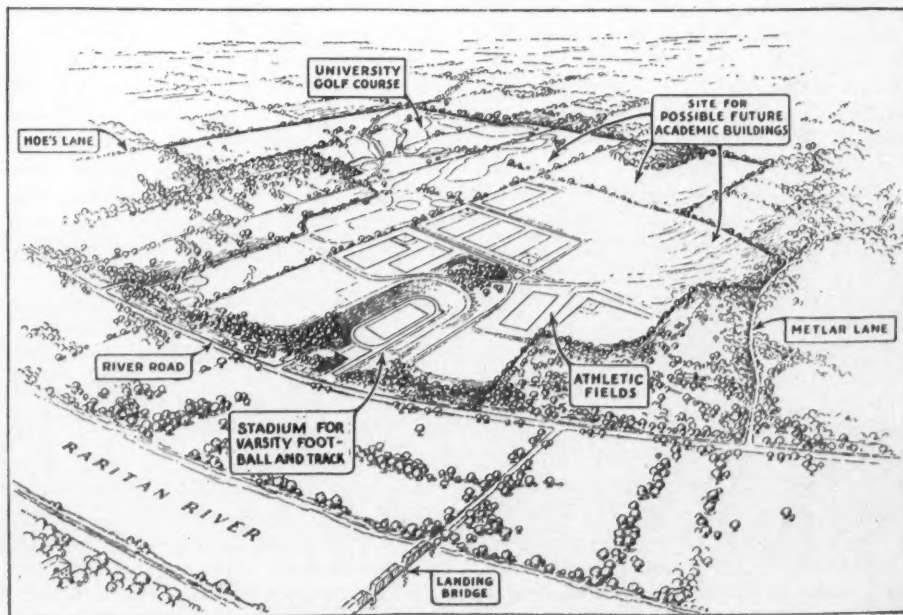
Selection of the site was determined to be of paramount importance. Principal desirable features were listed as beauty of surroundings, accessibility, and adaptability. The setting should be inviting, as it has been found that students will make greater use of the playing fields if they are made a part of the natural countryside. Accessibility is important alike to the public that desires to witness contests and the students that make use of the facilities. The latter, it was decided, should get their exercise on the fields rather than through the labor of

reaching them. Adaptability means primarily the ease with which the site can be changed so as to fulfill its various functions. Where heavy earth or rock movements must be made to create fields, the expense is severe and where deep fills are called for, playing surfaces can be maintained level only with great difficulty and at an unjustified cost. It was determined, for example, that a 4-foot fill is the limit for economical compaction and grading. The character of the ground also has a bearing on the costs, and the conclusion was reached that a topographical and soil survey should always be made in advance of purchasing a site as insurance against unexpected expense.

The question of area was considered at

length and it was concluded that no matter how much land is acquired, it will probably prove none too great. Including seats for spectators, an exhibition field suitable for intercollegiate and soccer football, lacrosse, and track meets, requires nine acres. A baseball field with the outfield arranged for other sports, such as football, calls for five acres. A double baseball diamond, arranged for transformation into four gridirons, takes up nine acres. For parking spaces that may be quickly filled or emptied, an acre is required for every 200 cars.

Other prime requisites of a suitable site are an adequate supply of drinking water and, in some cases, of irrigating water; and topographical conditions that will permit



ARTIST'S PERSPECTIVE OF THE DEVELOPMENT

GRADING THE INTRA-MURAL FIELDS

Most of the 350 men employed on the project are leveling the three terrace areas for the playing fields; the exhibition baseball field, and the university practice football field. These operations involve the movement of 36,518 cubic yards of top soil and 24,461 cubic yards of sub-soil, virtually all of which is being accomplished by hand methods.



of providing drainage and sewage disposal facilities economically.

Having completed their studies, Messrs. Little and Barrett laid out on paper their interpretations of an ideal layout of adequate size to serve a student body of 5,000. The exhibition field for football was made the central unit, with the other facilities grouped around it. They then considered this ideal plan in relation to the physical features of the site at their disposal and made such modifications as seemed to be required. The resulting layout is shown in an accompanying drawing.

The Rutgers site consists of 256 acres of land located one mile from the campus of the university, which is in the heart of New Brunswick. This distance is not considered an obstacle, in view of the fact that automobiles are sufficiently numerous among the students to provide transportation for everyone. The ground overlooks the valley of the nearby Raritan River, and affords a view in every direction of the rolling countryside, its wooded expanse broken here and there by farmlands under cultivation. Adjoining it is the 9-hole golf course owned by the school. The surface slopes gently towards the river, providing good drainage and permitting of leveling off the various intra-mural fields at moderate expense and without necessitating cuts and fills greater

than the 4-foot limit that has been determined as desirable. There is an average of 15 inches of topsoil. As this is of vital importance for the growth of turf, it is being carefully husbanded, as will be presently described. By coupling a pumping well with an artesian well, a sufficient supply of water can be obtained for irrigating both the golf course and the playing field.

The location of the principal exhibition field or stadium was determined by the topography. Advantage was taken of the presence of a small, relatively shallow ravine on the riverward side of the site. By widening this depression and using the material thus secured to build roads and fill in for play fields, automobile parking areas, etc., a level field is being created at a minimum of expense. Moreover, by excavating the sides and the upper end on a uniform slope, it will be possible to provide seats resting directly on the ground, and without the necessity of erecting supporting structures, save for the upper tiers that will extend above the ground level. The procedure of hollowing out a ravine in this manner follows the practice of the ancient Greeks, who constructed their stadiums and amphitheatres in this manner when the topographical conditions were favorable. The scheme has also been carried out previously in this country: first by Tacoma,

Wash., High School in 1910 and, a few years later, by the University of Colorado, at Boulder, Colo.

The stadium will be U-shaped, with one end open. It will be 568 feet long and 290 feet wide inside. When all of the projected seats are in place, the overall length will be 690 feet and the width 624 feet. The interior dimensions are such as to permit the use of the field for intercollegiate and soccer football and lacrosse. The respective space requirements of these sports are shown on an accompanying drawing. Circling the field will be a quarter-mile cinder track, with a straightaway extending out the open end. This will be long enough to permit the running of a 400-meter race with but one turn. This straight section will be 33 feet wide between curbs, sufficient to accommodate 11 sprinters at a time. Tracks of this width or wider are numerous in the western part of the country, but there is none east of the Mississippi River. Other portions of the track will be 25 feet wide.

This main exhibition field will not be used for baseball and this exclusion has permitted certain refinements to be made in the encircling track. Chief among these will be the banking of the curves. Theoretically the runner should at all times be perpendicular to the running surface, but as speeds vary in the different races, it is impossible to provide for this. The best that can be done is to compromise. In this instance, the pitch will be gauged to the average speed of the fleetest runners in the 400-meter distance.

The initial installation of seats, numbering 22,830, will be confined to the sides and one end. There will be 16,800 between the 5-yard football lines, equally divided between the two sides, and 6,030 at the end. Additional facilities will be provided as the demand for them arises. Eventually, accommodations can be provided for 50,000 persons. A 40x300-foot field house will be

built under the stands at one side, with tunnel connections to the field for the players. A modern press stand will be provided at the top of the opposite stand, with a platform constructed expressly for the taking of photographs, including motion pictures with sound.

Adjacent to the exhibition field will be a practice gridiron for the use of the University team. It will be flood-lighted so that it may be used in the late afternoons of the autumn. Near this practice field will be the exhibition baseball diamond, with stands for spectators.

As the accompanying plan shows, the facilities for the intra-mural athletics will be grouped in another portion of the plot. They will consist of three fields, each occupying a terrace formed by grading the sloping ground. The upper field will accommodate a single gridiron. The next lower one will provide space for four gridirons and two baseball diamonds, the latter being arranged in diagonally opposed corners so that the turf of the gridirons will form their outfields. The lower field will have one baseball diamond and two gridirons.

Construction work at the site has been underway since last November 20, with Mr. Barrett serving as superintendent. It is a Works Progress Administration project and has been providing employment for about 350 men, each working 130 hours a month.

The greatest amount of excavation is required to form the bowl for the exhibition field, the estimated quantity of material to be removed being 161,986 cubic yards. This work was about 60 per cent completed on September 1. The first operation was to strip off the top soil with hand labor and store it at either side, outside the excavation lines. Beneath the top soil is a red shale that is compact enough to require blasting. This is being taken out in two lifts, the maximum cut required being 43 feet. Four Ingersoll-Rand Type D wagon drills, equipped with X-71 drifter machines drill vertical holes 20 feet deep on 8-foot centers. Compressed air for operating them is supplied by four Type 20 portable compressors. Blasting is done with 40 per cent gelatine dynamite, holes being loaded so as to shake the material thoroughly without throwing it far. Four power shovels load the broken rock into 18 trucks, which dump it in low places that have to be brought up to grade.

The method of grading the intra-mural play fields represented a decided contrast with that employed in the bowl. In the latter area, virtually all work was done by manual labor, the only exceptions being a small amount of power shovel excavating, and the occasional use of air-operated paving breakers for digging in hard spots. The top soil was first removed and stored in ridges on 100-foot centers. Groups of men armed with picks and shovels then excavated the areas between these. The material was loaded into 2-yard construction cars

running on narrow gauge railroad tracks. When a string of cars was loaded, a detail of men pushed it to the lower end of the field for dumping, and pushed the empties back. After the excavation reached grade, the top soil was transferred from the ridges to adjoining areas and the projecting ribs were then removed by the same process.

To insure adequate drainage, 31,500 feet of 6-inch tile pipe and 2,100 feet of 10-inch tile pipe is being laid under various fields. All the water will be led to the upper end of the stadium and there emptied into a 48-inch pipe, of which 1,140 feet will be buried longitudinally along the center.

The finishing of the surfaces, after all sub-grading is accomplished, will constitute considerable of a task in itself. The plan at Rutgers is to spread 12 to 14 inches of coarse, hard-coal cinders, and compact them into a 10-inch layer by rolling. Over this the top soil will be placed and graded. At the same time any soil deficiencies for growing and maintaining turf that may be disclosed by analysis will be corrected. The university is fortunate in having as a member of its faculty Dr. Howard B. Sprague, one of the foremost authorities on soil and turf structure, and details of the finishing touches will be left in his hands. As preliminaries to the planting of grass, summer crops of soy beans or Sudan grass, and winter crops of vetch and rye will be grown. The final result will be a sturdy, level, well-drained turf providing a springy surface desirable for athletic competition and so well drained that it can be used within an hour or two after a hard rain. Approximately 30 acres will be seeded.

The development at Rutgers is being financed jointly by the school and Government. The university bought the tract of

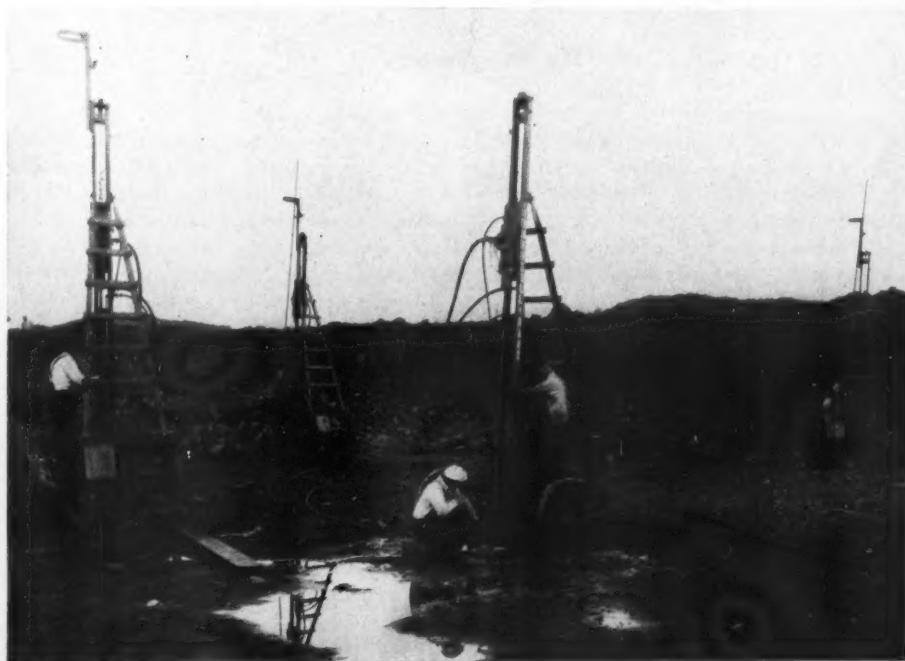
land, at a cost of \$98,390. A grant of \$321,124 was then received from the Government to cover the cost of excavation, grading and turf building. It is estimated that something over \$200,000 additional will be required for providing seats in the stadium and building the field house and a further Federal grant will be requested for this purpose.

Upon its completion, this entire physical training area will be used by the 1,200 students of Rutgers University and the stadium will be used for interscholastic track and field meets as well as for intercollegiate games. A systematic plan of usage has been worked out by Mr. Little whereby virtually all the facilities can be used to serve their purpose in both autumn and spring.

The present era of intercollegiate football was ushered in at Rutgers University, the first contest in the United States having been played against Princeton University at New Brunswick on November 6, 1869. The field that was used has long since passed from service and the gymnasium now occupies it. The athletic authorities of Princeton University have graciously offered to schedule a game with Rutgers to dedicate the new stadium. Whether or not this offer will be accepted has not yet been determined. It is not expected that the field will be available for use until 1937.

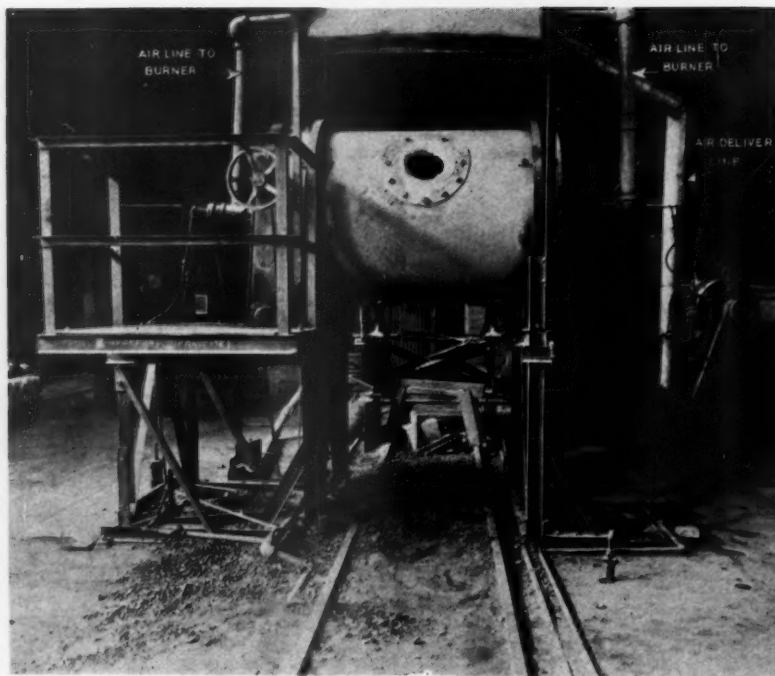
Nielson Field, the present exhibition athletic grounds of the school, will be converted into tennis courts when the new development is ready for use.

Assisting Mr. Barrett in the direction of the construction work are Harry Oliver as supervisor of labor, A. Pompino as supervising engineer, and L. F. Boyce as office supervisor.



DRILLING AT STADIUM SITE

Holes 20 feet deep are being drilled on 8-foot centers by four X-71 drifter drills on Type D wagon mountings. The material is a red shale that lies in slightly dipping beds.



ALWAYS READY FOR SERVICE

The rotary melter, showing a section of the overhead tank in which the air fed to the burners is superheated. After it has been charged with iron, the furnace is revolved once every fifteen minutes until the melt is completed. It has a capacity of 1 ton, and keeps the casting machine supplied with metal.

Gray Iron Cast Under Pressure in Metal Molds

A. M. Hoffmann

AS THE result of many years of experience in the die casting of nonferrous metals, the Wetherill Engineering Company of Philadelphia, Pa., has developed a method of producing ferrous castings that is a big advance over prevailing foundry practices. The company has for a long time specialized in die casting copper alloys, turning out intricate and difficult designs by a process originated by Col. Samuel Price Wetherill, the president of the concern and a pioneer in the die casting of aluminum alloys and aluminum bronze. Colonel Wetherill always has been an advocate of the gray-iron casting, and it was his belief that his process could be adapted for the making of such castings, thus doing away with the old-fashioned, cumbersome methods in general use.

By the Wetherill pressure, bottom-pour process, the molten metal is fed to the dies with compressed air, the metal as it rises forcing out through vents any contained

air and gases. However, nonferrous metals have a lower melting point than iron and steel, and before gray iron could be cast in permanent molds in a like manner it was necessary first to provide dies that would withstand higher temperatures. The dies produced are a decided innovation. They consist of a thin shell or liner of cold-rolled steel that conforms in shape and size to the casting to be made, and of an outer and supporting framework of cast iron between and around which cooling air can be circulated. When cores are required, collapsible metal ones are used, making it possible to produce chilled or nonchilled castings, as may be desired. The liners are free to expand and contract, and permit removing the finished work without the use of ejectors.

With that phase of the problem disposed of, the engineers set about devising a suitable furnace and ladle. To be economically practicable, the furnace not only had to melt quickly large quantities of iron but

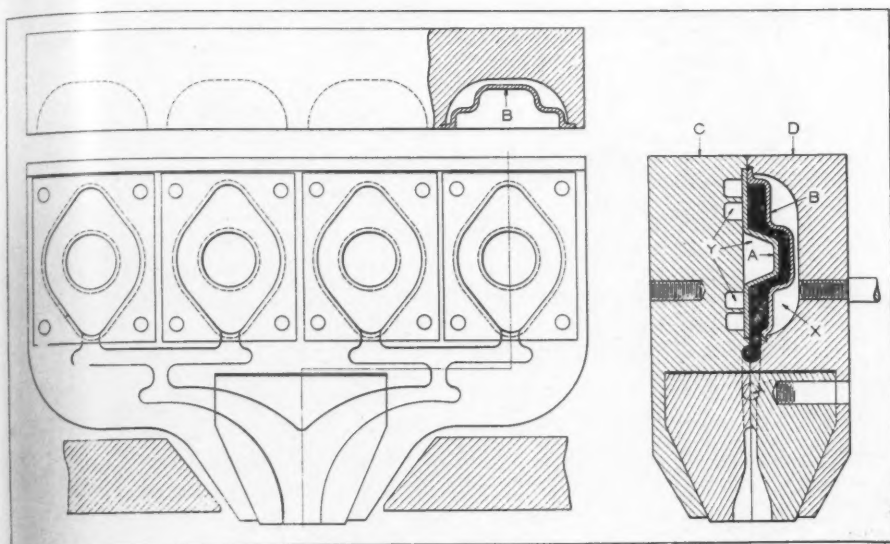


FIRST SEMICOMMERCIAL INSTALLATION

This Wetherill die-casting machine has a capacity of 400 pounds per load and is installed in the plant of the Alan Wood Steel Company, Conshohocken, Pa., where it is producing castings ranging in weight from 5 to 50 pounds each. It is shown with the die in place on top of the crucible unit. While it is used there to cast 2X foundry iron, the process is also suitable for the making of castings having a nickel or a silicon content. To the left is seen the track over which the ladle is run to and from the rotary melter.

also had to assure a continuous supply. The Wetherill rotary furnace is said to fill both these demands. Viewed from the mechanical standpoint, it is of simple design. One of its features is a well-nigh indestructible lining which, together with certain other structural parts, is protected by patents.

The furnace is fired at both ends with a mixture of oil and air, the latter being admitted at a pressure of from 16 to 20 pounds into an overhead tank where it is preheated and maintained at a temperature of 800°F. Thence it is fed to the burners by piping, as indicated in one of our illustra-



Courtesy, Machinery

DIE FEATURES

At the right is a cross section of a single die showing the structural parts in relation to one another. A and B, steel liners; C and D, cast-iron die blocks; X and Y, pockets in the die blocks which permit cool or preheated air to be circulated around the liners, depending upon whether a chilled or a nonchilled casting is desired. The general arrangement of a 4-unit die is illustrated at the left.

tions. From a cold start, and when consuming 900 cubic feet of air per minute and 24 gallons of crude oil per hour, a ton of No. 2X foundry iron, including 20 per cent scrap iron, can be melted and brought to a temperature of 2,750°F. within 2¾ hours. From then on, it is possible to produce a 1-ton melt every 1¾ hours, or sufficient to supply a die-casting machine with a capacity of 400 pounds. This is not the maximum, and the company is now engaged in designing a unit that will hold 1,000 tons of molten metal.

The essential features of the casting machine are a crucible unit set between two structural-steel uprights, and a pneumatic cylinder suspended from a bar connecting the upper ends of the uprights. The crucible unit is shown in an accompanying cross-sectional drawing, and consists of a cylindrical steel shell "H" lined with a refractory; of a crucible "A" seated in a half crucible "B" and on two disks "C" and closed by a lid "E," all made of Syncarb, a product of the Ross-Tacony Crucible Company; of a nozzle "D" reaching almost to the bottom of the crucible; and of a sleeve "F" on top of the latter.

So that we may understand the method of operation, let us follow the making of a gray-iron casting from start to finish. The die set, the upper half of which is secured to the air-cylinder piston, is raised and lowered and held firmly in position during casting by the pneumatic cylinder with air at a pressure of 100 pounds. But before it is spotted over the nozzle, there is placed in seat "L" an asbestos gasket ¼ inch thick. This seal is compressed about ⅛ inch when the die is brought down on top of it, and is renewed after each operation. Stops control the movement of the piston and prevent damaging the crucible unit.

Transfer of the molten metal is made by means of a patented ladle, and is effected without exposing the contents at any time to the atmosphere—that is, to oxidation. The ladle is mounted on a carriage and is like crucible "A" in design. After it has been filled at the furnace it is run along tracks to the casting unit where its load is discharged into the crucible through the pouring plug "M." This is done with compressed air, and in the same manner in which the iron is fed to the dies, as described in the next paragraph.

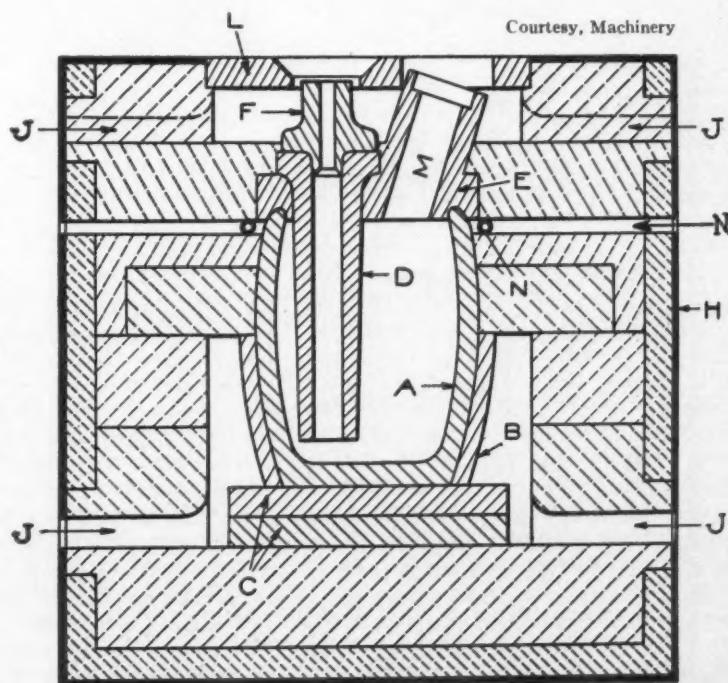
When the crucible has been charged, plug "M" is closed, and a 1-inch pipe con-

nection made through which preheated air at 20 pounds pressure is admitted. This forces the molten metal up through the nozzle into the die, driving out through vents provided for the purpose all contained air and gases and thus completely filling the cavities. All the while four gas burners, inserted through as many openings, "J," in the shell and lining, keep the metal at a temperature of approximately 2,650°F. The air pressure is also maintained, and metal continues to be fed to the die until the casting has reached a stage where shrinkage no longer takes place. While the metal is under pressure it has a tendency to escape from under the crucible lid. To prevent this loss there is laid around the top of the crucible a 1-inch pipe "N" through which air at room temperature is blown while casting is in progress. This causes the metal at that point to freeze and effectually to seal the joint.

The procedure, as just recited, takes less than a minute, and either single or multiple castings can be produced. These are characterized by a structure that is dense, close grained, and remarkably free from blow holes and oxidation; and tests have proved them to have a far higher tensile strength than those made in the customary way. Furthermore, by eliminating sand, and by reason of the fact that they can be held close to specified dimensions—0.005 inch plus or minus—castings made by the Wetherill process have smooth surfaces and can, in many cases, be used just as they come from the dies, that is, they require no machining other than grinding off the gates. The process is especially recommended for the production of disks, rollers, wheels, cylinders, flanges, blocks, and other solid, simple castings that can be made without the employment of collapsible cores.

CRUCIBLE UNIT

A, crucible; B, half crucible; C, disks; D, nozzle; E, crucible lid; F, sleeve; H, cylindrical steel shell; J, openings for gas burners; L, die seat; M, pouring plug; N, air pipe.



Courtesy, Machinery

Separate Water System Protects City Against Fire

MUCH of the destruction that was visited upon San Francisco by the 1906 earthquake resulted from the failure of the water-supply system and the consequent inability to fight the fires that broke out in various parts of the city. With a view to preparedness in the event of a similar catastrophe, San Francisco has provided a water-distribution system that is designed exclusively for fire-fighting and that is independent of the facilities that furnish the ordinary water requirements. It consists of reservoirs at three locations and of inter-connecting pipe lines which feed the distribution mains.

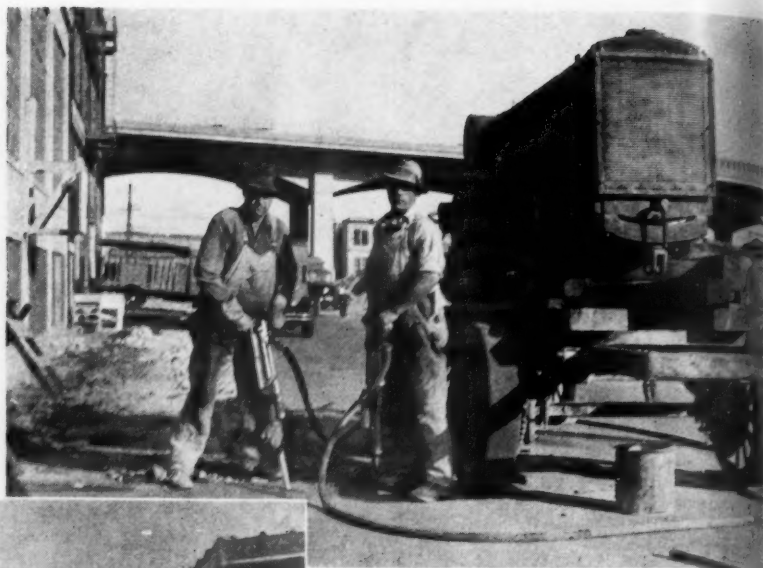
The main storage reservoirs are situated on Twin Peaks at an elevation of 760 feet and have a capacity of 10,000,000 gallons. Two 20-inch mains extend from them to the distribution network. However, as this great head imposes a pressure on the lines that is unnecessary save for very big fires and that is dangerous to maintain, the protected district has been divided into two zones arranged according to their elevation. The lower zone includes areas less than 150 feet above sea level, and is supplied with water from a 750,000-gallon reservoir at elevation 335. The upper zone embraces areas above elevation 150 and is supplied from a 500,000-gallon reservoir at elevation 490. The principal business and manufacturing activity of the city is within the lower or congested zone, and it is girded with 18- and 14-inch mains and gridironed with 14- and 12-inch mains.

Taking water from its respective reservoir, each zone is normally served at pressures ranging up to 150 pounds, depending upon the elevation. But provisions are made whereby either zone can be directly connected with the Twin Peaks reservoirs whenever an emergency creates a demand for higher pressures. Without resorting to this additional head, however, the pressure is great enough to throw water to a height of twelve stories without the use of pumping engines. As each hydrant is designed with six hose connections, there is no necessity for moving pumping equipment to a fire. The time that elapses between the receipt of an alarm and the actual application of water has thus been materially re-

duced, and, what is equally important, the general efficiency of the fire department has been increased.

When the water mains are connected with the high-level Twin Peaks reservoirs, the pressure at the hydrants in some sections is as much as 300 pounds. As this is too great for safety, a reducing valve is interposed between the hydrant and the hose. This appliance was invented by an employee of the city, and suffices to lower the pressure to any desired point between zero and 120 pounds. Each valve has two 3-inch outlets, and three of them, or six hose lines, can be attached to one hydrant. They can be used simultaneously or independently, according to requirements, and each is equipped with a pressure-controlling device.

The Twin Peaks reservoirs are supplied with fresh water by a pumping station located at the reservoir that takes care of the upper of the two zones. The two lower



BUILDING AND TESTING SYSTEM

Above are shown workmen cutting through pavement with air-driven tools to start the excavation for a pipe-line trench. In the background is the San Francisco approach to the new bridge that will connect the city with Oakland. In the picture at the left is seen a test of the high-pressure fire-fighting system. The streams of water were thrown higher than the top of the 12-story building on the right.



reservoirs ordinarily draw on Twin Peaks, but provision has been made whereby water can be obtained elsewhere in the event of breakage of the mains by reason of an earthquake or from some other cause. These standby facilities consist of two salt-water pumping plants having their intakes in the bay. In order to make them independent of outside sources of power, they are arranged to be driven with steam which is generated by burning fuel oil. An adequate supply of oil for 96 hours of operation is stored in five underground steel tanks. Fresh water for the boilers and for other plant purposes is likewise kept in concrete reservoirs beneath the boiler room. Steam is maintained in these stations at all times so that they can be pressed into service at a moment's notice. Each plant has a capacity of 24,000 gpm.

San Francisco is continually extending this high-pressure system to include sections of the city not now served by it. Under contracts recently completed, 25.7 miles of main was laid, bringing the total now in service to 104.2 miles. Cast-iron pipe is used, and it is placed at a depth of 5 feet. Portable compressors, rock drills, paving breakers, and other compressed-air equipment are extensively employed in excavating the necessary trenches.

Thus far, the high-pressure system has cost \$7,750,000. It is estimated, however, that it has brought about reductions in fire-insurance premiums aggregating \$1,000,000 annually, and this saving alone is considered ample justification for the expenditure.

Making Winter Weather in the Movies



EVERYONE knows that everything is not what it seems to be in the movies. Moreover, few people care how the various effects are obtained, so long as there is verisimilitude in the cinematic make-believe. To the credit of the film industry, it can be truthfully said that there is a continual striving towards better technical craftsmanship. New artifices are being put forward all the while to increase the screen's realism. One of the latest ideas along this line came not from within the industry but from an ice manufacturer, the California Consumers Corporation of Los Angeles. Owning a number of large refrigerated warehouses, this concern suggested using one of them for a refrigerated sound stage, and that is what has been done.

The building has nearly one-third of an acre of floor space, and its ceiling is 42 feet high. It is well insulated and soundproof, so that two major requirements were met at the outset. This entire "stage" can be converted into any desired winter scene in a short time. For one picture the whole area may become a skating rink, for another an Eskimo village, etc. To provide unusually low temperatures, additional ammonia piping has been suspended from the ceiling.

Special apparatus was devised to crush conventional 300-pound blocks of ice into powder, thereby "manufacturing" snow. This is blown onto the set by compressed air; and the blast can be controlled so as to simulate snowstorms varying in intensity from one of a mild character to a raging blizzard.

In the old days it was customary to send film companies on location in the high Sierras. More often than not they would have to wait for just the kind of weather the script called for. That procedure was extremely expensive, so Hollywood technicians took steps to imitate winter settings in the studios or close by them. Crystal

camphor rubbed on windows looked like frost; a mixture of gypsum and salt laid on the ground, roofs, and fences passed for snow; bleached corn was used for snowflakes; and icicles were formed in various ways. Regardless of the skill with which the settings were prepared, however, the breath of the actors could not be photographed, and the effect of realism was not obtained.

The low temperatures of the refrigerated stage make it possible to duplicate actual

WINTER INDOORS

A corner in a refrigerated warehouse with the stage set and the actors in position. Notice the banks of ammonia pipes overhead, and the blocks of real ice at the left. The picture at the top shows a stream of synthetic snow being sprayed with compressed air upon an igloo made of cakes of ice.

winter conditions, even to the visible breath. Miniature lakes can be frozen in woodland settings, and icicles can be quickly formed by merely allowing water to drip. An Eskimo village can be made of blocks of real ice, and the igloos given a frosty coating by blowing snow over them. Actors naturally portray their parts more realistically and effectively in a frigid atmosphere, with the result that there is a notable decrease in the number of retakes of the required scenes.

Raising O'Shaughnessy Dam

THE work of raising O'Shaughnessy Dam, the principal storage structure in San Francisco's water-supply system, is now in progress. Upon its completion, the crest will be 430 feet above bed-rock, or 85.5 feet higher than it is at present, and the capacity of the reservoir behind it will be 117,000,000,000 gallons, or approximately 70 per cent greater than before. The addition is not for the purpose of increasing San Francisco's water supply, as the capacity of the system is ample for many years to come. The primary reason for it is to make it possible to develop more hydro-electric energy.

The City of San Francisco has an arrangement with the Pacific Gas & Electric Company whereby the latter acts as its agent for the distribution of power. The contract provides that the utility shall take all available power from the Moccasin Power House, which is interposed in the water-supply delivery line at a point below O'Shaughnessy Dam. In order to secure the maximum revenue from this source, sufficient water is released from O'Shaughnessy Dam to insure the full output of 25,000 hp. of electrical energy at the Moccasin plant for as long a period of each year as water is available. At certain times the withdrawal is 400,000,000 gallons daily. In June the flow of the Tuolumne River, which O'Shaughnessy Dam spans, is normally great enough to fill the reservoir twice; but during the winter months it ordinarily drops to such an extent that the

Moccasin Power House turbines can be operated at only a small fraction of their capacity. It is estimated that the increased storage capacity of the reservoir will serve to supplement the revenue derived from power sales by \$225,000 annually.

The plan of heightening the dam was conceived when the structure was built during the years 1920 to 1923. Accordingly, the foundations were constructed to carry the extra load, and they will not have to be altered in any way. The dam is of the concrete, arch-gravity type having a crest length of 605 feet and a maximum thickness at the base of 308 feet. It contains 398,000 cubic yards of concrete, and the present operations call for an additional 268,000 cubic yards. It is said that this increment in height is unprecedented in the case of a structure of this type and size. The dam thickness is being increased in proportion, the concrete being poured on the downstream face.

With this in mind, the downstream face was originally built in the form of a series of set-backs or steps 5 feet high. The general procedure consists of roughening the steps to secure a good bond between the new and the old concrete, and of setting in them and grouting in place numerous anchor bars which will extend into the new concrete for a distance of 10 feet. Approximately 25,000 lineal feet of drilling will be required to provide holes for these bars. When the dam was constructed, copper water-stops were inserted in the crest and



DOWNSTREAM FACE

The figures are those of drillers who are putting in holes for anchor bolts that will tie the newly poured concrete to the old structure.

their projecting ends were encased in a temporary wooden box. These strips are now being embedded in the new concrete so as to insure watertightness along the horizontal joint.

The greatest problem involved in the new work is to make the old and new sections act like a homogeneous structure. The existing concrete is from thirteen to sixteen years old, and has undergone about all the shrinkage that can be expected of it, whereas the new concrete will be subjected to shrinkage. To insure early knitting and to prevent overloading of the old concrete, it is proposed to do two things: first, to use concrete that will have an initial higher strength than that originally poured; and, second, to cool the new concrete artificially. The last will be achieved by embedding in the mass, on approximately 5-foot centers, pipe loops that will permit the circulation of water—first reservoir water, and later refrigerated water, as was done at Boulder Dam. The concrete will be placed by means of a high-level cableway supplemented by two shorter paralleling cableways at a lower level. The work involves an expenditure of approximately \$4,000,000. It is being done under contract by the Transbay Construction Company.

O'Shaughnessy Dam is incorporated in the Hetch Hetchy system which delivers water to San Francisco from the High Sierra. It is situated approximately 160 miles from the city. As it is in Yosemite National Park, the work now underway is subject to restrictions imposed by the National Park Service to prevent undue scarring of the landscape. The City of San Francisco has invested more than \$80,000,000 in the development of this water-supply system, which was described in our July, 1933, issue.



AN AIR HOIST AT WORK

This double-drum "Utility" hoist aids in handling various materials on the downstream face of the dam.

Does Artificially Induced Heat Increase the World's Temperature?

WE SELDOM give thought to the fact that we are all living in compressed air, and that compressed air is absolutely necessary to our existence. Similarly, very few of us are aware of the tremendousness of this supply of air. I figured it out not long ago, and I stumbled upon it in this way. I was watching the thousands of automobiles rushing back and forth on the streets and avenues of New York City. I said to myself, "Surely, all this burning gasoline must have an appreciable effect upon the temperature of the earth's atmosphere. Millions of tons of coal are consumed throughout the world every year. This coal develops an enormous amount of heat which is eventually absorbed by the air. Consequently, the air is warmed. In addition, millions of cords of wood and millions of barrels of oil are burned. Doesn't it seem logical that all this heat generated by combustion should make the atmosphere warmer?"

I decided to figure it out, and so wrote three letters to the foremost authorities in the United States in the three respective fields—coal, oil and gas, and wood. As a result I found that the world's total heat generated annually is as follows:

Coal	35,250,000,000,000,000 Btu's
Oil and gas	4,220,000,000,000,000 "
Wood	12,900,000,000,000,000 "

Total 52,370,000,000,000,000 Btu's

Next it is necessary to know the total amount of air enveloping this earth. This is a comparatively easy question to answer, because textbooks tell us that the pressure of air on every square inch of the earth's surface is very close to 14.7 pounds per square inch. It is thus merely a matter of determining the area of the earth's surface in square inches and multiplying by 14.7. The answer is: 11,850,000,000,000,000 pounds of air. Now that we have the total heat and the total weight of air, and know-

ing that 0.2375 Btu. will raise the temperature of one pound of air one degree Fahrenheit, we get:

$$52,370,000,000,000,000 \text{ Btu's} \div 0.2375 = 220,000,000,000,000,000 = \text{the number of pounds of air whose temperature would be increased one degree by the total heat.}$$

However, I find that there is much more air in the world than 220,000,000,000,000,000 pounds: there are 11,880,000,000,000,000,000 pounds, the latter figure being 54 times the other. To be exact, all the heat produced on earth per annum will increase the temperature of our atmosphere only

one fifty-fourth of one degree. Or, it takes 54 years for all the heat applied at the same rate every year to raise the temperature of our atmosphere one degree.

In view of this extremely small temperature increase; in view of the fact that vegetation absorbs carbon dioxide, one of the products of combustion; and in view of many things that I do not fully understand, I conclude that the temperature of our atmosphere remains unaffected by the activities of human beings. Maybe I am right. Maybe I am wrong.

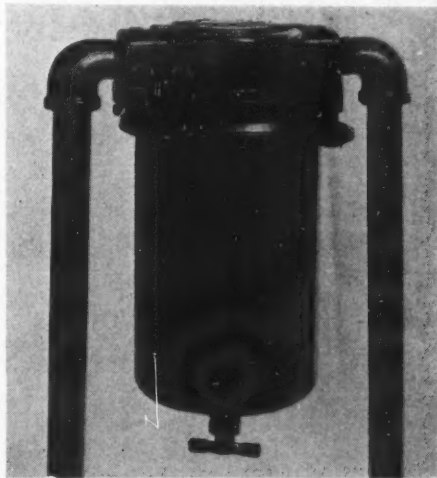
W. F. Schaphorst

Special Air Separator for the Sand-Blast Operator

FOR sand-blast operators and others who wear masks or special breathing apparatus supplied with compressed air, the Motor Improvements, Inc., has provided an air-line separator that removes fumes in addition to the entrained oil and water. The unit consists of one of the company's regular Purolators rearranged to take a charge of about a pound of activated carbon through which the air passes after the oil and moisture have been removed from it. The container is capped with a 60-mesh screen and wool to prevent particles of the carbon from being carried over into the air line.

The life of the carbon depends upon the quantity of fumes present; but under the worst conditions of 8-hour service, and handling 6 cfm., should not require replacement for six months. The material is said to hold many times its own bulk in organic vapors (not acid gas nor carbon monoxide), and to offer little opposition to the flow of air. Objectionable carbon monoxide has been rendered harmless by compressing the air containing it to 50 pounds, the pressure tending to combine the free oxygen of the air with the carbon monoxide to form car-

bon dioxide. Where hydrogen sulphide is present, a charge consisting of three parts carbon and one part soda lime is used.



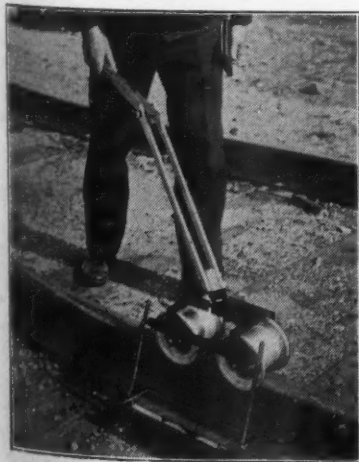
New Safety Glass

RESEARCH extending over a period of six years has resulted in the production of a high-test laminated safety glass that is said to be a marked improvement over what is now known as safety glass. It represents the joint efforts of the Pittsburgh Plate Glass Company and of the Carbide & Carbon Chemicals Corporation, and its secret lies in a new synthetic plastic, called Vinal, which possesses high elasticity and tensile strength.

According to a recent announcement of the Pittsburgh Plate Glass Company, the newest safety glass can be cut without the application of heat and can be cemented without the use of adhesives; it will not discolor when exposed to sunlight nor disintegrate when subjected to extreme atmospheric heat; it is ten times as resistant as other glass of its kind to a temperature of 10° below zero Fahrenheit and five times as resistant at 70°F.; and when broken will stretch and bend even upon further impact and can be rolled up without presenting cutting edges and with the glass and the plastic remaining virtually intact.

Device Helps Trackwalker Inspect Rails

TO FACILITATE the inspection of rails in place, the trackwalker has been provided with a simple apparatus by the Mag-




netic Signal Company of Los Angeles, Calif. The unit is known as the Sands Rail Inspector, and makes it possible without stooping to examine parts of a rail that are normally hidden from view. It consists of a handle, of two flanged wheels arranged in tandem that travel along the top of the rail, and of a mirror mounted alongside the wheels. Both the mirror and the handle are adjustable so as to meet all requirements as to height and focus.

As the trackwalker pushes the contrivance ahead of him on his tour of inspection he can look right down on to the mirror in which the web and underside of the head of half the rail are reflected and magnified approximately twice their actual size. Imperfections that are otherwise difficult if not impossible to detect are thus made visible without eyestrain, and the work is speeded up tremendously.



A MATTER OF DEGREES

 September marks the two-hundredth anniversary of the death of Gabriel Daniel Fahrenheit, who gave us the thermometer that is now used for ordinary purposes in English-speaking countries. The year 1936 is also the two-hundred-fiftieth anniversary of his birth, which took place in Danzig, on May 14, 1686. He lived most of his adult life in England and Holland, subsisting by manufacturing meteorological instruments.

Galileo built the first instrument for showing temperatures, about 1612. It consisted of a glass tube containing air and having one end immersed in a colored liquid. Being affected by variations in atmospheric pressure, it was not accurate. A few years later he devised the first liquid thermometer, alcohol being the fluid used.

Fahrenheit improved on this and other earlier thermometers by using mercury, which, when heated, expands at a more uniform rate than any other liquid. Others had attempted to employ it, but Fahrenheit was the first to find a method of eliminating the impurities which had theretofore affected its accuracy.

Previous thermometer builders had recognized that some sort of a scale was essential in order to correlate the readings of various instruments, and also to obtain a basis for expressing the degree of heat or cold. As the lower limit they took the coldest day they could remember and as the upper one the body temperature of cattle. Sir Isaac Newton next proposed a scale having its zero at the freezing point of water and assuming 12 degrees to be the temperature of the human body.

Fahrenheit suggested making zero the lowest temperature that could be obtained with a mixture of ice and salt, and dividing the scale between it and the body temperature into 12 degrees. That placed the freezing point of water at 4 degrees. Subsequently he split each degree into eight. On this modified scale, the freezing point of water became 32 degrees and the body temperature 96 degrees. The former figure remains

correct to this day, but it has been determined that the body temperature is some two degrees higher than it was then measured.

Up to Fahrenheit's time it was believed that the temperature at which water boiled was variable, but he showed that it was always the same at the same atmospheric pressure. This paved the way for setting a third constant point on the scale. Readings fixed it at 212 degrees, which we recognize as accurate today.

STADIUMS OF THE PAST



THE central unit of the new Rutgers University outdoor athletic development that is described in this issue is a stadium that will be hollowed out of the ground in much the same way that they were sometimes built by the ancient Greeks that originated them. Its seating capacity will be less than many others in the United States, but in beauty of setting and treatment, and refinements of its playing field it will rival any such creations of past or present periods.

A little research discloses many interesting facts about the old Greek and Roman forums of sports. The word "stadium" originally denoted a measure of length. It equaled 600 Greek feet and varied according to the value of the foot in different parts of the empire. The Olympic stadium was equivalent to some 630 modern feet. The stadium was a popular distance for foot races and ultimately gave its name to the structures that were erected so that people might better watch them. They were built in the shape of a U, with one end open so as to provide a longer straightaway on the running track.

The most notable Greek stadiums were at Athens and Olympia. The former was of standard shape and has been restored with marble from the original quarry. The structure at Olympia was apparently rectangular.

The Roman counterpart of the stadium was the circus. It was built primarily for

chariot races and stables were placed across the open end of the U. The best known structure of this type was the Circus Maximus in Rome. In Constantine's time it had a seating capacity generally estimated at from 350,000 to 385,000, or more than three times that of any modern assembly place. It was 2,000 feet long and 600 feet wide, over-all. The standard chariot race was seven laps and as many as 100 races were run in a day.

The Greeks also designed the theater, which means "a place for seeing." The first one was built sometime before 500 B. C. The seats covered slightly more than a semi-circle, although in the latter Roman models they formed exactly half a circle. In both the Greek and Roman structures, the stage was built across the open end and the space between it and the seats was used by the chorus that marched and sang. The great Dionysiac Theater in Athens was carved out of rock at the base of the Acropolis and looked out on the Greek temples and the Aegean Sea.

When the seats entirely surrounded the center space, the structure was called an amphitheater. The Romans originated it for their gladiatorial contests and it survived in the form of the bull-fight arenas in Spain. The word "arena" came from the Latin "sand," which material was spread on the ground to soak up the blood. The most famous of these structures was the Flavian amphitheater or Colosseum, which was built in Rome about 80 A.D. It was erected entirely above ground, was composed of fine travertine stone and seated about 45,000 persons. During the Middle Ages it became a quarry and comparatively little of it remains. The best preserved of the ancient amphitheaters is at Arles, France.

The Yale bowl is a true amphitheater. It was built on the level by excavating from the center and heaping the earth in embankments on which the seats rest without supporting beams or columns. It covers more than twice as much area as did the Colosseum and seats 61,000 persons. Incidentally, many consider it to be the most enduring of modern structures.

Industrial Notes

Announcement has been made of a new kind of glass that is said to be glareless and therefore to reveal plainly any underlying object regardless of the angle from which it is viewed. One surface is clear and the other is treated so as to deflect light rays. It is recommended for use in connection with instruments, meters, etc.

Koppers Products Company is offering an aluminum paint for coating creosoted timbers. Lumino Aluminum Paint, as it is called, has a chemically processed tar base and is put on without a sealer. To be most effective, the paint should be applied by the spray method and the wood should be well seasoned.

The Illinois State Division of Highways has set an example in economy that is worth noting. In a contract covering the reconstruction of a 4-mile stretch of U. S. Highway 40, that department specified that the concrete on the old 18-foot-wide road be recovered and crushed to a maximum size of 3 inches and used to build up the subgrade for the new 40-foot highway.

By means of a newly developed process, ordinary granule-surfaced asphalt roofing shingles are being coated with hydraulic cement which gives them, it is claimed, rigidity, added durability and insulating value, and more resistance to fire and weather. These shingles are offered for sale under the name of Cementop. Similar white slabs for siding also are available.

A United States patent has been allowed on a method of producing copper of high electrical conductivity that is virtually free from oxygen and sulphur. According to the claims, air is blown into the molten metal to remove impurities; next the copper is overpoled to lower the oxygen content; then a lithium-bearing substance is added to get rid of the gases; and after that the metal is cast in a manner to prevent the access of air.

Making a V-Type Motor is the title of a new film which has been produced under the supervision of the U. S. Bureau of Mines and which is available for free distribution, other than the cost of transportation, to educational institutions of all kinds. The pictures were taken in the Rouge plant of the Ford Motor Company and show the manufacture of that type of oil engine from start to finish. To obtain the film, address the Pittsburgh Experiment Station, U. S. Bureau of Mines, Pittsburgh, Pa.

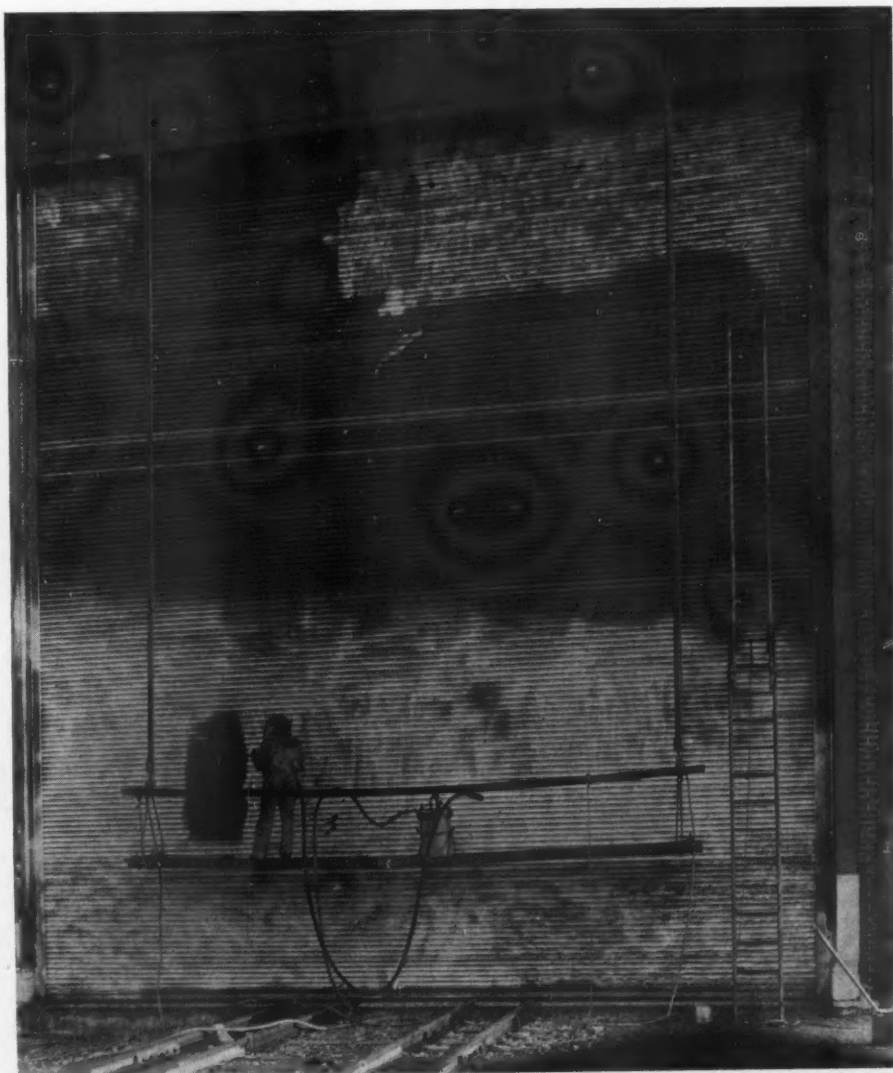
Basel, Switzerland, has become a seaport. For the first time in its history an ocean-going vessel has reached that inland city. It brought a consignment of 400 tons of sugar from London and took eight days to make the journey. The freighter, the

Bernina, has a length of approximately 246 feet, a beam of 24.5 feet, and a draft of 8.75 feet, and was especially designed to navigate the shallows and the swift waters encountered on the Rhine. It is propelled by a diesel engine.

Painting metal stacks, standpipes, and the like by remote control and thus eliminating all the hazards usually attending that work is among the newest of mechanical achievements. At least we are informed that a patent has been issued recently on a robot painter which climbs up and down and around such structures under its own power. The contraption is mounted on four pneumatic wheels that are driven forward, backward, to the right, or to the left by an electric motor, and is provided with four additional wheels that are magnetized by an electromagnet, thus holding the de-

vice fast to the vertical walls. A container and spray nozzles complete the equipment. The painting is done with compressed air, and all the operations are controlled by a man safely stationed on the ground.

Waste porcelain is being put to effective use in Denmark, where it is serving to mark traffic lanes on busy highways and curves to prevent accidents. According to the U. S. Department of Foreign and Domestic Commerce, it is crushed to a fineness of from 3/32 to 5/16 inch and is cemented to the pavement by hard bitumen. To assure a firm bond a light flux is added to the latter, and this vaporizes quickly as soon as the mixture is applied. Stripes of this kind are not only lasting but will render the same service after dark as they do during the day because of the high reflective power of the porcelain chips.



PAINT REMOVAL MADE EASY

Paint can be sprayed on as well as off with the assistance of compressed air, as this picture shows. The stripping solution used on this large steel door is a product of the American Chemical Paint Company, Ambler, Pa. It is allowed to remain in place for from 2 to 24 hours, depending upon the character of the paint, and when loose is washed off with water. After the surface has been thoroughly dried it is ready for a new coat.

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